Managed Stand Yield Tables for Coastal Douglas-fir: Initial Density and Precommercial Thinning

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Managed Stand Yield Tables for Coastal Douglas-fir: Initial Density and Precommercial Thinning

by

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ABSTRACT

Managed stand yield tables are presented for second-growth stands of coastal Douglas-fir, *Pseudotsuga menziesii* (Mirb.) Franco, established naturally (4440 trees per hectare) or planted with 300, 500, 750, 1110, or 2500 trees per hectare. Separate tables describe the development of stands thinned to 500 or 1110 stems when 6 m tall. Conventional variables are summarized in addition to crop tree and crown parameters, and stand and stock tables. These yield statistics are produced by a biologically oriented tree and stand simulation model (TASS) calibrated to conform with the yield of remeasured plots. The yield tables are supported by site index tables, graphs of yield relationships, and a discussion of stand dynamics.

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INTRODUCTION

The managed stand yield tables in this report present estimates of the growth and yield of second-growth stands of coastal Douglas-fir, *Pseudotsuga menziesii* (Mirb.) Franco, established at various densities following planting, precommercial thinning, or natural regeneration. The supporting documentation describes the development, application, interpretation, and limitations of these interim yield tables. Site index curves and a glossary of technical terms are included for convenience. The yield tables are the first in a series that will address the species and treatments of greatest interest in British Columbia.

Yield tables for managed stands differ from normal (full stocking: e.g., McArdle *et al.* 1961), empirical (average stocking: e.g., Fligg 1960), and variable density yield tables (e.g., Visziai 1982) in that they incorporate the effects of one or more management variables (i.e. silvicultural treatments) in addition to age and site variables which are common to all tables. Density in managed stand yield tables is not an independent variable as in variable density yield tables, although it is one of many dependent variables that reflect the action of stand dynamics and the intervention of management practices. That is, density changes as time and treatment influence the development of forests established at different densities.

Managed stand yield tables describe the physical development of treated forests in quantitative units familiar to the planner, silviculturist, economist, protection specialist, and others responsible for implementing and assessing intensive forestry practices. The growth and yield information is an essential component of the programs developed in British Columbia to ensure sound forest management and abundant forest resources in perpetuity.

Coastal Growth and Yield Program

Although isolated studies date back to 1915, formal growth and yield research did not begin in British Columbia until the Forest Research Division was organized in 1927. The field program of 1929 included the thinning of an 18-year-old stand of Douglas-fir near Lake Cowichan, and the establishment of the Schenstrom Thinning Plots[1] which have been measured 13 times in the past 55 years (Warrack 1979). Over 400 untreated plots were located in stands of natural origin as part of an expanding program in the 1930's and 1940's. The complex CCT (Correlated Curve Trend, O'Connor 1935) thinning trials and other studies initiated in the 1950's examined the impact of silvicultural treatments on growth and yield. The Research Division designed two large experiments with 211 plots in the 1960's to investigate the performance of seven species planted at three densities. In the 1970's, the Forest Productivity Committee launched a large thinning and fertilization experiment with 940 plots. Today, the Forest Research Branch is responsible for approximately 1400 plots on the coast, half of which are Douglas-fir. Data were summarized manually until the magnitude of the accumulated information necessitated the development of a computerized data base and summary system. Plot records from the United States, New Zealand, France, and other countries managing Douglas-fir have also been added to the system. Only a fraction of the summarized data was available from 1980 to 1982 when the yield tables in this report were constructed. Later versions will benefit from the expanded data base.

Modelling

The construction of yield tables from plot data gradually became the responsibility of the "stand modeller", as the usefulness of modelling and simulation techniques became apparent in forest research. Several types of models emerged (Mitchell 1980). **Whole stand models** recognize the stand as the basic unit that responds to environmental factors and silvicultural practices. Species, age, site quality, and density or management regime are related directly to volume, basal area, diameter, height, number of trees, and other stand parameters. These models are ideal for short-term growth projections of conventional inventory plots in support of management plans. Yield tables can be generated by the more sophisticated systems such as DFSIM (Curtis *et al.* 1981). Whole stand models are usually inexpensive to operate, and accurate within the range of the basic data.

Individual tree models such as PROGNOSIS (Stage 1973) differ in that they retain information about every tree in a simulated stand. This may include the spatial position or co-ordinates of each stem (Newnham[2]; Lin 1974), and its vigour, competitive stress, and upper stem diameters. The tree is the basic biological unit of growth rather than the stand, which is now an aggregation of competing stems. Trees respond to the localized impact of environmental factors and stand treatments. These individual tree models do not attempt to forecast the development of particular trees measured in the field. Instead, they simulate the growth of trees as a means of incorporating the dynamics of stand development into yield projections. The depth of detail or realism is only

[1] S.R. Schenstrom. 1931. Thinning experiments in Douglas-fir forests of British Columbia. Unpubl. manuscript. B.C. Min. of For. Library Victoria, B.C.

[2] R.M. Newnham. 1964. The development of a model for Douglas-fir. Ph.D. thesis, Univ. of British Columbia, Vancouver, B.C.

limited by the modeller's ability to understand and simulate the biological processes that drive the growth of trees and forests.

Crown models (Arney 1972; Mitchell 1969, 1975*a*) employ the crown as the centre of activity for growth, and competition for growing space. These models are extensions of individual tree models and invariably incorporate inter-tree distances. The systems mimic the biological processes with considerable fidelity. High resolution, sensitivity, and a variety of treatment options are among their attractive features. Small changes or perturbations can be traced through the system over the life of the stand. Crown models are particularly adept at exploring regions beyond the domain of the Ministry of Forests' existing basic data and experience. Foresters can simulate the growth and yield of understocked stands, for example, even though data from remeasured plots are not available. Simulators may be the only source of information available in these situations. Crown models are costly to develop and operate because of their attention to detail and dependence on foresters with highly specialized training. They may not project the growth of inventory plots unless unconventional data or procedures are available (Mitchell 1975*b*). They can, however, evaluate silvicultural options, and produce managed stand yield tables. The Tree and Stand Simulator (TASS) was designed for this purpose.

TREE AND STAND SIMULATOR (TASS)

Development

The Tree and Stand Simulator (TASS) is an integral part of the growth and yield program in the Research Branch. Development of the system began in 1963 as a research project of the Canadian Forestry Service, with interim support provided by Yale University, University of British Columbia, and the University of Idaho.

TASS I was based on data from stands of white spruce, *Picea glauca* (Moench) Voss, near Prince George, B.C. (Mitchell 1969). Annual height growth, branch extension, and bole dimensions were among the variables measured. The analysis of Douglas-fir trees near Lake Cowichan from 1968 to 1970 contributed to the construction of a new system, TASS IIA, which was refined and tested by 1973 (Mitchell 1975*a*). The structure of the model was later revamped to increase the efficiency of the computer routines and the ease with which scientists could execute simulated experiments. The new version, TASS IIB, has been upgraded regularly since it became operational in 1976. Coefficients for interior lodgepole pine, *Pinus contorta* Dougl. var. *latifolia* Engelm, have been added to TASS II, following the analysis of trees from various locations in British Columbia[3]. New parameters are being derived for white spruce since TASS I is no longer in use.

The model grows trees in a three-dimensional growing space simulated within a computer. The crowns of individual trees expand and contract asymmetrically in response to internal growth processes, physical restrictions imposed by the crowns of competitors, environmental factors (site quality, defoliation, animal damage), and cultural practices (thinning, pruning, fertilization). The crowns add a shell of foliage each year that benefits the trees in diminishing amounts for several years. The volume increment produced by the foliage is distributed over the bole annually and accumulated to provide tree and stand statistics. Figure 1 illustrates the development of a 10- by 12-m plot from age 0 to 45, including a thinning at 37 years. The growth of every branch shown in these physical models is simulated by the computer and identified on the crown maps used to construct these miniature forests.

The processes that drive the development of individual trees in TASS include height growth, branch extension, accumulation of foliage, production and distribution of bole increment, suppression of height growth, and mortality. These processes are affected by site quality, inter-tree competition, thinning, pruning, fertilization, defoliation, animal damage, and genetic variation among trees. Variation in height growth, for example, ensures that some trees, relative to others, will grow more slowly and succumb to competition earlier. The most vigorous individuals will likely survive until harvested. The impact of this stochastic process is evident in the population of simulated trees in Figure 1. Heavy mortality of the least vigorous trees tends to upgrade the vigour and apparent productivity of the stand, particularly when the initial density is high. The process of stagnation or height growth repression[4], which can reduce the growth of all trees in dense stands, is not included in the model. Consequently, TASS may overestimate the growth of these stands until repression is understood and modelled.

TASS has been used as an investigative and teaching tool to examine the impact of environmental factors and cultural practices on the growth and yield of coastal Douglas-fir. Computer experiments have examined initial density and spatial distribution of trees, precommercial thinning (juvenile spacing), commercial thinning, fertilization, pruning, tree improvement programs, defoliation, and deer browsing. Each experiment has shown that the model can produce realistic results and provide considerable insight into the dynamics of stand development. A variety of yield tables have been constructed since 1978, many of which have addressed special situations such as the interplanting of understocked plantations.

Validation

Physical stand models (Figure 1) provide visual assurance that the system functions realistically. The size of the crowns and boles, variation among trees, differentiation of crown classes, thinning response, and other properties are reasonable. Growth statistics produced by tests of greater sensitivity show that the impact of precommercial thinning, for example, is reflected in the dimensions of the crop trees throughout the rotation.

Ultimately, simulation models must be calibrated to duplicate the growth of actual stands with acceptable accuracy. Calibration, which removes bias in the model by altering strategic coefficients, is necessary because most growth relationships are developed from short-term measurements of various parts of undamaged

[3] J.W. Goudie. 1980. Yield tables for managed stands of lodgepole pine in northern Idaho and southeastern British Columbia. M.Sc. thesis, Univ. of Idaho, Moscow, Idaho.

[4] K.J. Mitchell. 1980. Stagnant lodgepole pine. *In* Proc. of the Research Activities Meeting Vol. II. B.C. Min. For., Research Branch, Victoria, B.C.

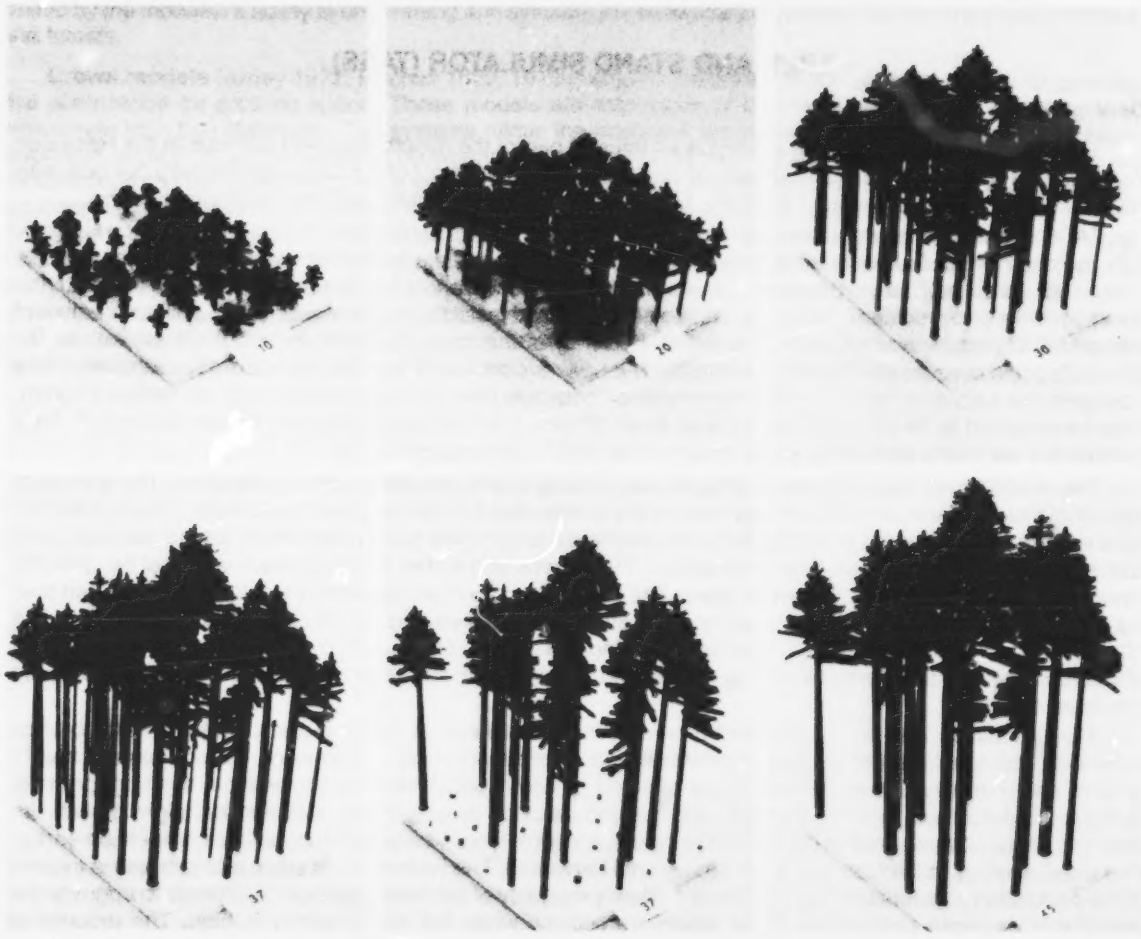


FIGURE 1. Physical models depicting the operation of TASS during the simulated development of a typical plot to age 45.

trees. Hence, calibration compensates for unavoidable shortcomings of the sampling design, as well as the omission of environmental disturbances (such as endemic pests, brush, and climatic extremes) and other factors that usually impede growth. This procedure is not applicable to traditional yield tables or whole stand models because age, site quality, and other independent variables are related directly to unit-area productivity. Initial calibration in 1971 was based on 16 thinning plots in a 1941 plantation near Lake Cowichan. Good agreement was achieved (Mitchell 1975*a*). Later, TASS was recalibrated to conform with the Research Branch summaries available in 1981. Most plots were located in dense stands of natural origin. Approximately 500 plots provided by co-operators in the Pacific Northwest also contributed to the refinement of the system.

The Ministry of Forests' espacement and precommercial thinning (PCT) trials were summarized in 1984, and compared with TASS yields produced earlier for this report. The validity of the simulations can be judged in Figures 2*a-f*, which also include volume and height data from Haney[5], Wind River[6] (Reukema 1979), Martha Creek[6] (Steele 1955; D.L. Reukema, personal communication, September 1981), and Champenoux[7] (Oswald and Pardé 1976). Some plot-to-plot variation in the relationship between volume and height may reflect the

[5] J.H.G. Smith. 1983. Graphical summaries and data of the U.B.C. Research Forest spacing trials (57-5) to age 26 and evaluation of results to date. Unpubl. progress report. Faculty of Forestry, Univ. of British Columbia, Vancouver, B.C.

[6] Wind River Experimental Forest near Carson, Washington.

[7] Amance Forest near Nancy, France.

assumptions used to convert the available graphical and tabular information to common measures and units. The rationale for using these variables, and the definition of each, are explained later. The actual and simulated volumes compare favourably within the limited range of data. Unfortunately, the height of these plots rarely exceeds 20 m. The estimated yield of low-density stands at greater heights is almost entirely dependent upon the biological growth properties inherent in the model. Yields from TASS and fully stocked plots reaching heights of 50 m are shown later.

Comparison of yields generated by TASS and DFSIM will also contribute to model validation, given the independent development of the systems using different methods and data. Initial results are encouraging[8].

Operation

TASS currently operates on the B.C. Systems Corporation's IBM 3081 computer. Typical production runs require 20 to 60 seconds of processing time at a cost of $15-50. The user must specify the dimensions of the plot; number and spatial distribution (square, random, clumped etc.) of the trees; site index; maximum age to be simulated; and summary statistics required. The values of approximately 50 other variables with default options may be entered if required. Each treatment (such as thinning or pruning) must also be defined in terms of timing, type, and intensity. The output consists of tree and stand statistics, and crown maps. A simulated experiment usually consists of a number of carefully planned and integrated production runs of considerable complexity. The model is primarily a research tool that is not expected to be used by managers without the guidance of trained personnel.

---

[8] I.R. Cameron and K.J. Mitchell. 1983. Interim managed stand yield tables and planning estimates. *In* Proc. of the Coastal Growth and Yield Projections Information Day, Vancouver, B.C. H.J. Benskin (editor). B.C. Min. For., Victoria, B.C.

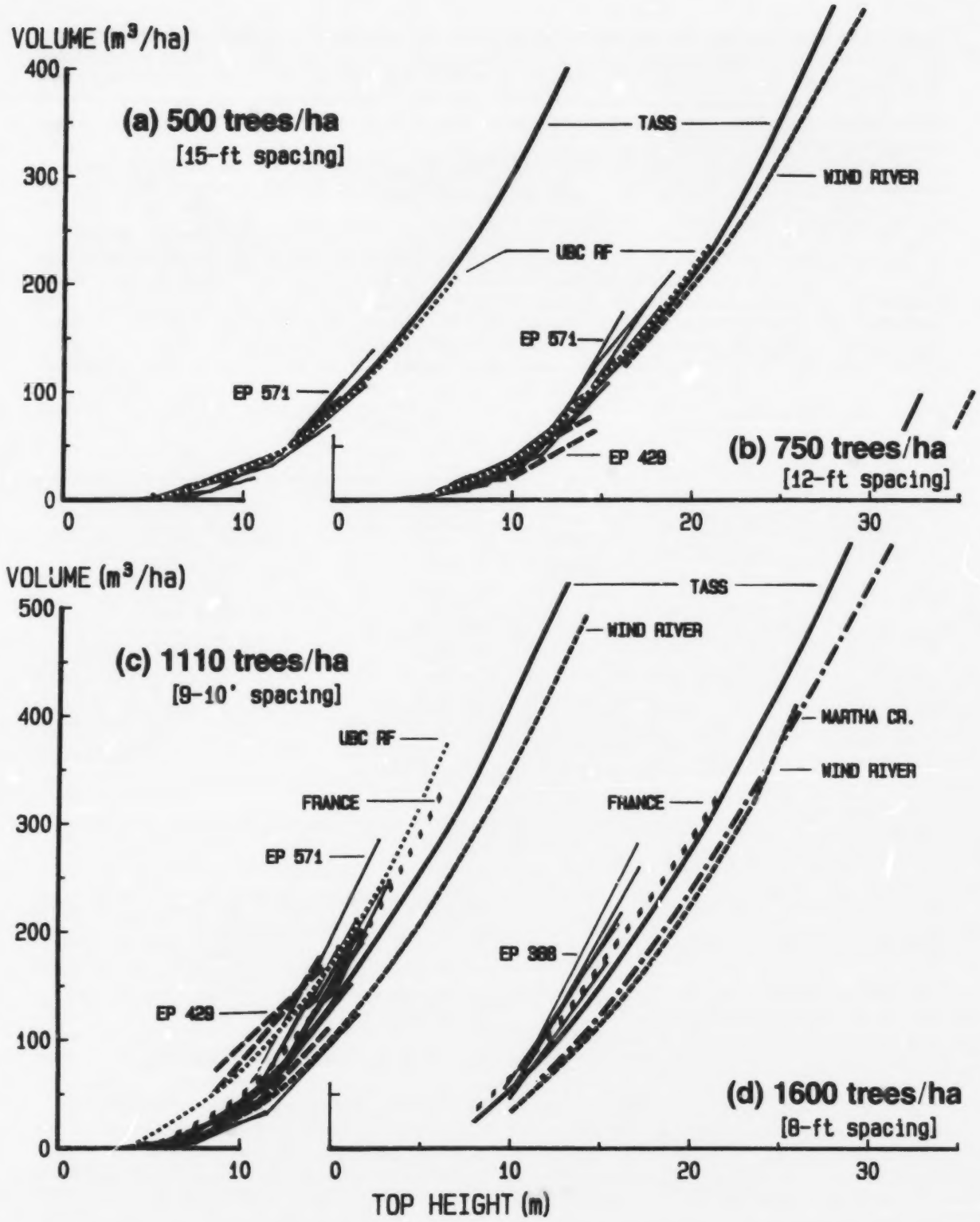
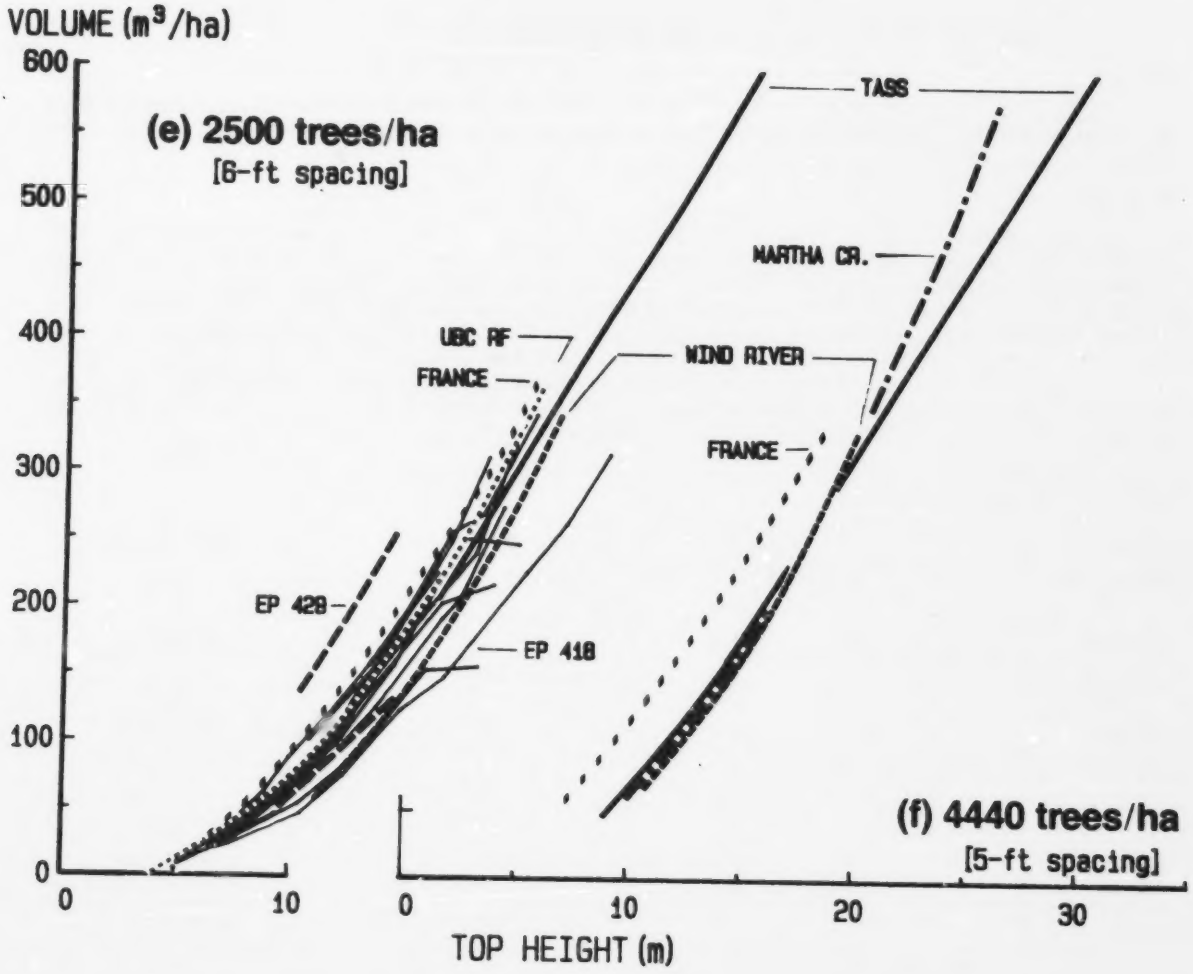


FIGURE 2a-d. Comparison of volume/height relationships from spacing trials and TASS at initial densities of (a) 500, (b) 750, (c) 1110, and (d) 1600 trees/ha.



LEGEND

Key	Agency	Location	Variables
EP 368	Research Br.	Ucluelet	Species
EP 418	Research Br.	Lake Cowichan	PCT (CCT design)
EP 429	Research Br.	Chilliwack	Espacement and species
EP 554	Research Br.	Sayward	PCT (CCT design)
EP 571	Research Br.	Franklin River	Espacement and species
EP 571	Research Br.	Port Renfrew	Espacement and species
UBC RF	Univ. of B.C.	Research Forest at Haney	Espacement
WIND RIVER	USFS	Carson, Wash.	Espacement
MARTHA CR.	USFS	Carson, Wash.	PCT
FRANCE	INRA-CNRF	Champenoux, France	Espacement

FIGURE 2e-f. Comparison of volume/height relationships from spacing trials and TASS at initial densities of (e) 2500 and (f) 4440 trees/ha.

YIELD TABLES

Design

The yield tables summarize the results of a series of TASS projections which are part of a carefully designed simulated experiment. The following design features are germane to the application and interpretation of the tables.

Treatments

Two management variables, initial density and precommercial thinning (PCT), and their associated treatment levels were simulated individually and in various combinations (Table 1). Stands were established with 4440 randomly distributed trees per hectare, or planted with 2500, 1110, 750, 500, and 300 stems per hectare to cover a wide range of initial densities. The development of these stands was simulated without further treatment. The densest condition (4440, unthinned) represents plots used to develop normal yield tables such as those constructed by McArdle *et al.* (1961). Trees did not germinate over a period of years, as may occur in nature. Planted trees in the other trials conformed to a square spacing pattern, with some random variation (± 0.15 m) permitted around the intended location. Plantations differed from natural stands only in terms of initial density and spatial distribution. TASS employs the same growth coefficients for all stands.

TABLE 1. Simulated treatments

Spatial distribution	Initial density and spacing				PCT density
	Trees		Spacing		trees
	(/ha)	*(/acre)*	*(m)*	*(ft)*	*(/ha)*
Random*	4440	1800	1.5	5.0	unthinned**
Random	4440	1800	1.5	5.0	1110 500
Square	2500	1000	2.0	6.5	unthinned 1110 500
Square	1110	450	3.0	10.0	unthinned 500
Square	750	300	3.7	12.0	unthinned
Square	500	200	4.5	14.5	unthinned
Square	300	120	5.8	20.0	unthinned***

* Depicts fully stocked stands of natural origin similar to those described by normal yield tables.

** Yields of dense unthinned stands (4440 and possibly 2500) may be optimistic because the impact of density on the height growth of dominant trees is not modelled.

*** No remeasured plot data are available to confirm any part of this yield table.

Stands with 4440 and 2500 stems per hectare were precommercially thinned to 1110 trees, favouring the tallest uniformly spaced trees. Treatment coincided with a height of 6 m when most candidates for removal were 4-5 m tall. Thinning at 3 m instead of 6 m would not alter the yields appreciably. Finally, stands with 4440, 2500, and 1110 stems were reduced to 500 stems for a total of 11 trials.

Sites

All site indices used in this report refer to height at 50 years **breast-height (bh) age**. "Site height" refers to the average height of those site trees selected to measure the site index of the stand. The term is used when the selection criterion is unknown or unimportant. For reasons of objectivity, Bruce (1981) and other mensurationists are adopting the European measure of top height (average height of the 100 per hectare of largest diameter) in place of the height of dominants and codominants, and other subjective measures of site height used in the past. Site curves developed by Bruce (1981) for coastal Douglas-fir are employed throughout this report. They are very similar to those constructed by King (1966).

Managed stand yield tables created by TASS are atypical in that height appears in place of age, and one table applies to a range of sites. The rationale behind this format dates back to 1904 when the German forester Eichorn reported that ". . . a given mean height of stand is matched by the same volume in all site classes"; and Gehrhardt later implied that ". . . the total crop yield was also without exception a function of the mean height" (cited by Assmann 1970, page 161). They recognized that the yield of fully stocked stands of the same height is

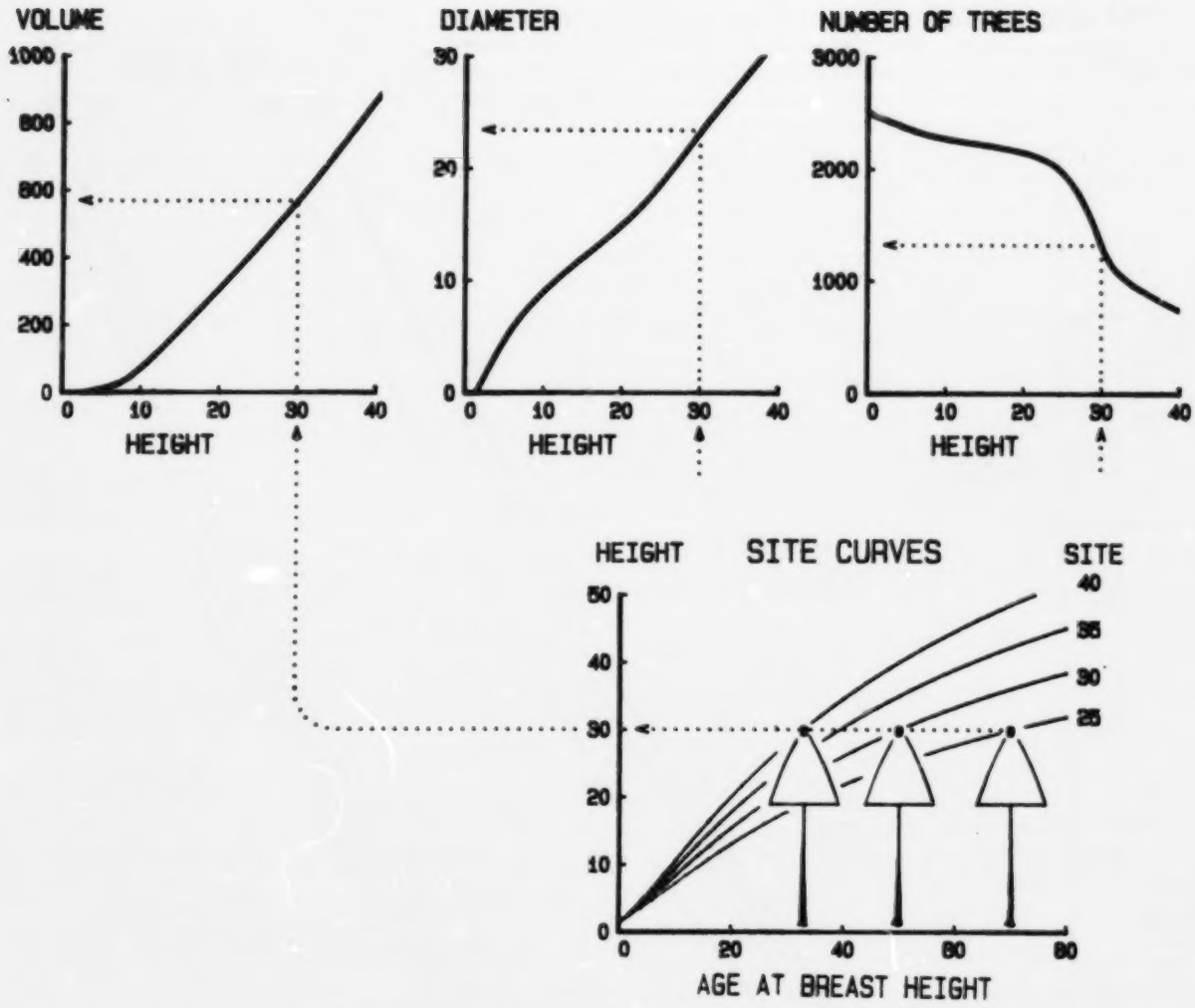


FIGURE 3. Volume, diameter, and number of trees can be estimated from height, which is a function of age and site.

similar, even though their ages and sites differ considerably. Figure 3 depicts the volume, diameter, and number of trees from three stands of the same height (30 m), but of different ages (33, 50, and 70 years) and sites (40, 30, and 25 m). Substitution of site height for mean height extends the principle to stands of lower stocking because this measure of height is reasonably independent of density.

Eichorn's principle can be observed in early yield tables by McArdle *et al.* (1961) and in data from remeasured plots, if volume is regressed against height by site classes (Figure 4). Sites above 33 m in McArdle's yield tables tend to diverge from the common trend observed on sites 19 to 33[9]. Trend lines from fully stocked permanent sample plots (Figure 4) show no consistent differences among the high and medium sites. However, very limited data suggest that stands on sites below 24 m may add more volume relative to height than stands on sites of higher productivity. Even though no consistent trend has emerged, it may not be prudent to apply this methodology to sites much below 24 m.

It is not uncommon to use height as the driving variable in yield projection systems when accurate site curves are available. European yield tables (Hummel and Christie 1957) have frequently been derived from volume/height (V/H) functions [$V = f_1(H)$] by substituting the relationship of height with age (A) and site (S) [$H = f_2(A,S)$], so that tables are given in the conventional form: $V = f_3(A,S)$.

[9] Site indices of 19, 26, 33, and 39 m at age 50 (bh) correspond to McArdle's values of 80, 110, 140, and 170 feet at total age 100.

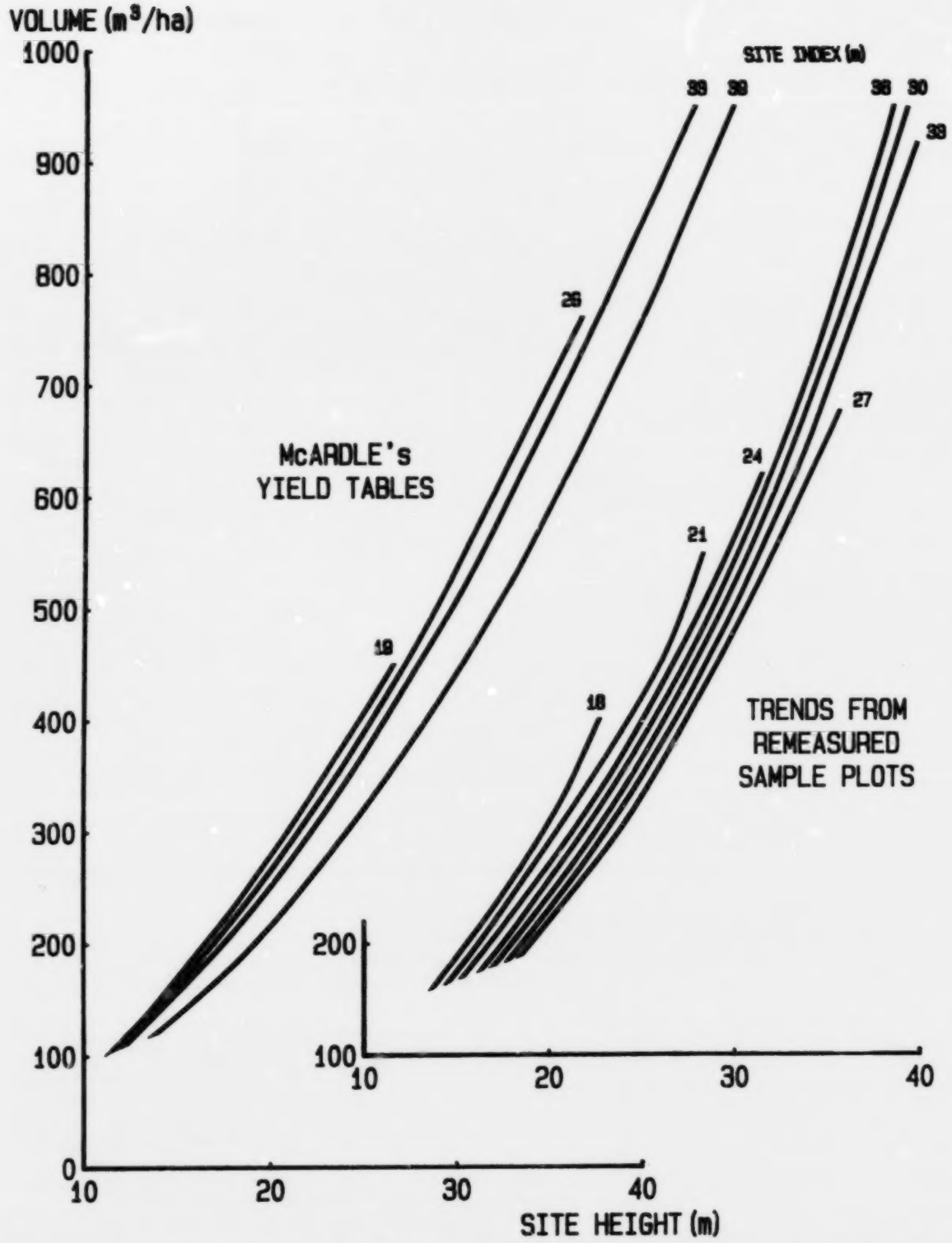


FIGURE 4. Relationship between volume and height, by site classes, observed in early yield tables and remeasured plots.

Figure 5 illustrates the procedure for constructing a volume/age curve for stands on site 35. Heights of 18, 30, 39, and 45 m, which correspond to a selected age sequence (20, 40, 60, and 80 years), are obtained from the site curves (lower right-hand graph) and passed through the volume/height relationship (upper left-hand graph) to derive the volume/age curve in the remaining graph. The procedure can be repeated for sites 25 and above, and for variables other than volume if their relationship to height has been derived from remeasured plot data.

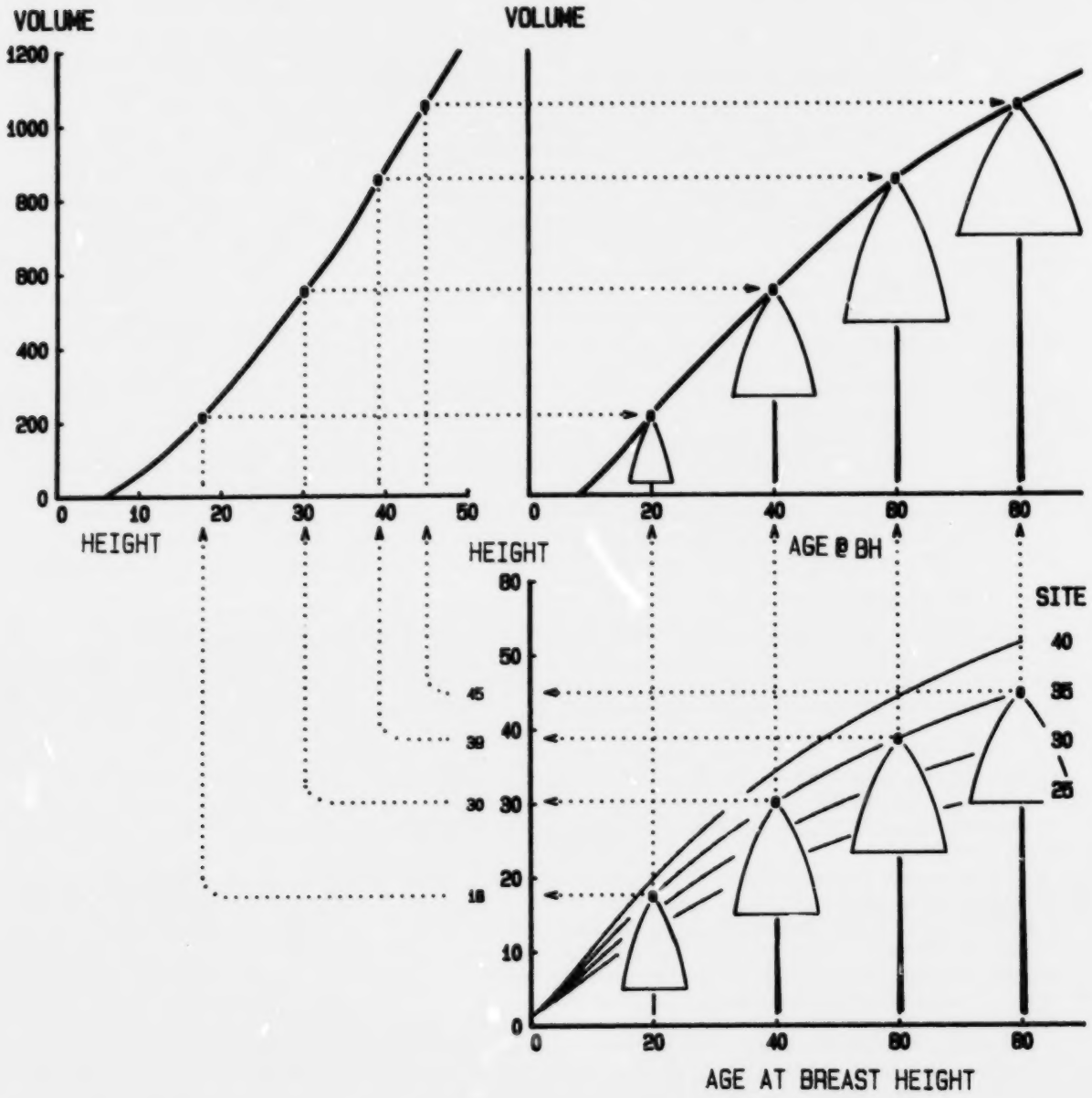


FIGURE 5. Procedure for constructing a volume/age curve from a volume/height relationship and set of site curves.

Yield Levels

TASS is calibrated to conform with the yield of remeasured plots such as those maintained by the Research Branch (Figure 6). Plots above 20 m of top height are situated in fully stocked stands of natural origin, while most others are in plantations or espacement trials established with 500–3000 trees per hectare. The plots did not receive further treatment. TASS projections for stands that bracket the data base (Figure 6) show that the model performs well, although close inspection suggests that yields may be slightly low in dense young plantations and possibly a little high in older stands.

TASS will predict yields in excess of what can be achieved operationally because microsite, irregular spacing, environmental conditions, and other factors contributing to "falldown" are not as carefully controlled in the operational environment as they are in research installations. Research plots are often treated, altered, or abandoned if damaged by pests, weather, or other agents.

The "empirical" curve (E) in Figure 7 summarizes the volume/height relationship of the randomly located inventory plots. The yield of these plots is lower and more variable than the research plots (Figure 6). The uppermost curve in Figure 6 appears in Figure 7, labelled "potential" (P), for comparison. It represents the TASS 4440 and 2500 volumes, which are very similar and quite close to the upper limit of the yields produced by research plots. The difference between the empirical and potential yield curves may reflect site occupancy, chronic losses, measurement and sampling error, and the productive potential of the site. **Site occupancy** refers to the effect of rock outcrops, small marshes, and other openings that create unproductive areas. Understocking associated with low regeneration density, clumping, brush competition, and mortality from insects, diseases, and other pests has a similar impact. Overstocked stands, on the other hand, can carry high volumes for short periods, but are unstable and prone to snow and ice damage. **Chronic losses** caused by insects, pests, and diseases can reduce volume growth without killing trees. Site occupancy and chronic losses are incorporated into yield estimates based on inventory plots because most are located in stands of natural origin without regard to density or pest damage. Research plots generally avoid "abnormal" conditions. **Measurement error** will introduce some variation into both types of plots. **Productive potential** recognizes that some areas may be inherently more productive than others, relative to top height. This concept is incorporated into the British Forest Management Tables (Bradley *et al.* 1971) as "Production Classes". The authors state that "factors which influence Production Class tend to be macro-climatical rather than specific to individual stands". Genetic make-up could also contribute to differences in the productive potential (D.L. Reukema, personal communication, June 1984).

Density warrants further attention because of the magnitude of its impact on yield. Curtis (1982) developed the following measure of relative density (RD) to classify plots according to the relationship between stand basal area (BA) and corresponding diameter at breast height (DBHg) derived from the tree of average basal area:

$$RD = BA(DBHg)^{-0.5}$$

He stated that the relative density of Douglas-fir "has a range from zero for zero basal area, through a value of about 9.5 for the 'normal' of McArdle and others (1961), to some biological maximum which appears to be about 14 for small plot observations". Relative density classes (Figure 8) can be derived from the plot data in Figure 7 by regressing volume (V) against height (H) and relative density (RD). That is,

$$V = 0.47656\ H^{1.39}\ RD^{0.97}$$

The potential and empirical curves in Figure 7 are superimposed on Figure 8 for comparison. Note that the curve of "maximum" density (RD = 14) recommended by Curtis (Figure 8) conforms with the upper limit of the plots displayed in Figure 7. Only 3% of the plots exceed this density. Volumes in excess of this limit are suspect and require confirmation.

The three yield curves in Figures 7 and 8 give perspective to the yields in this report. The "maximum" curve approximates the upper limit of yield as explained above. The potential curve is based on the highest volumes found in the yield tables. They represent stands established at relatively high densities (2500–4440 trees per hectare) and growing in a comparatively pest-free environment without climatic disturbances. Most research plots established before 1950 fall into this category. Note that the density of these plots (i.e. the potential curve in Figure 8) increases steadily from a condition of understocking (RD = 2-6) to one of full stocking at about RD 12, which is higher than the level of 9.5 reported by Curtis (1982) for normal yield tables. However, Curtis (personal communication, June 1984) has observed that "the small size and greater uniformity of research plots, particularly plantations, tend to give higher values". Minor differences in diameter limits and measures of height could also contribute to the discrepancy. The lower empirical curve describes the historic average yield produced by stands along the southern coast of British Columbia, which regenerated naturally to pure stands of Douglas-fir (80% +). Sites occupied by hardwoods and other conifers, instead of the more desirable species, are not included in this relationship.

The difference between the potential and empirical yield at 40 m of height is about 200 m^3, which equates to a reduction of 20%. It can be minimized if site preparation, planting, brushing, weeding, pest management, and other basic forestry practices achieve full stocking on all productive areas. Average yields will still fall short of the potential because rock outcrops and other physical obstructions reduce the number of plantable spots. Consequently, anticipated gains from basic forestry will vary in relation to the unproductive area in each unit, and the yield tables must be interpreted accordingly. Losses of 5–25% can be expected in management units at rotation age. Intensive forestry practices, particularly fertilization, can elevate production to a level that could exceed the potential if all other factors are favourable.

The volume projected for stands above 30 m of height is of particular concern because of its impact on the age at which mean annual increment culminates. Unfortunately, yield information is sparse and variable. Some sets of data, such as the one in Figure 6, show volumes sweeping upwards above 40 m of height. Others suggest a linear trend above 30 m which resembles the relationship in McArdle's yield tables (Figure 4). The exceptional volume increment of plots in the upper corner of Figure 6 is real, and would have to be sustained to achieve the 3500 m^3/ha reported by Worthington (1958). Trees on his fully stocked 0.4-ha plot were 87 m tall at 375 years. However, these growth rates may be limited to research plots that are carefully located and protected to ensure full occupation of the site. Randomly located plots, on the other hand, would likely incorporate the effects of insects, diseases, windthrow, and other factors that decelerate growth. Notice that some of the subjectively located plots in Figure 6 show the impact of snow and ice damage in 1968. Consequently the rate of mortality in TASS was accelerated slightly in stands above 40 m in height in order to maintain a reasonably linear trend. Additional allowance for irregular mortality caused by pests, climate, fire, and other factors must be incorporated later at the planning stage.

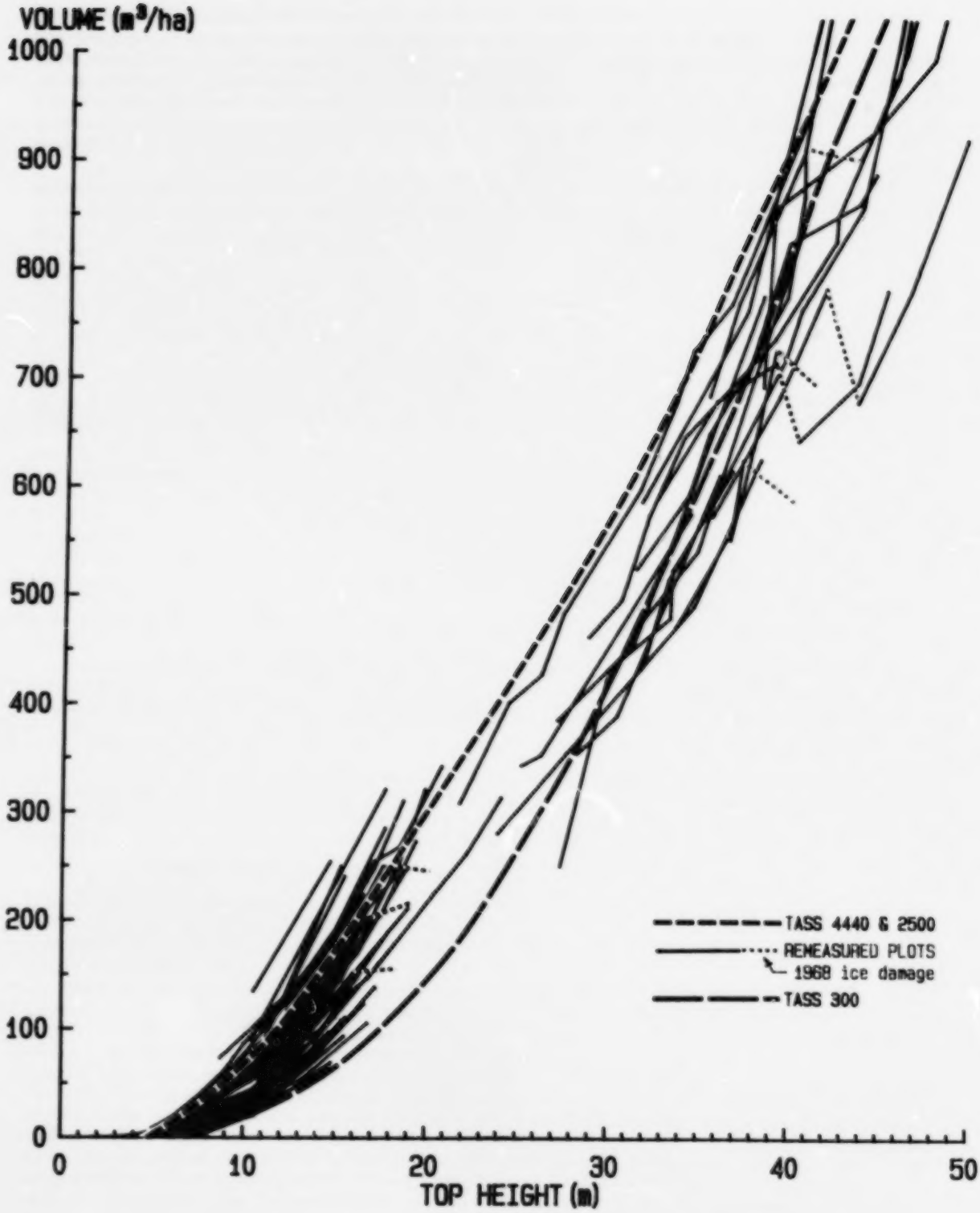


FIGURE 6. Comparison of volume/height relationships from Research Branch plots (unthinned) and TASS.

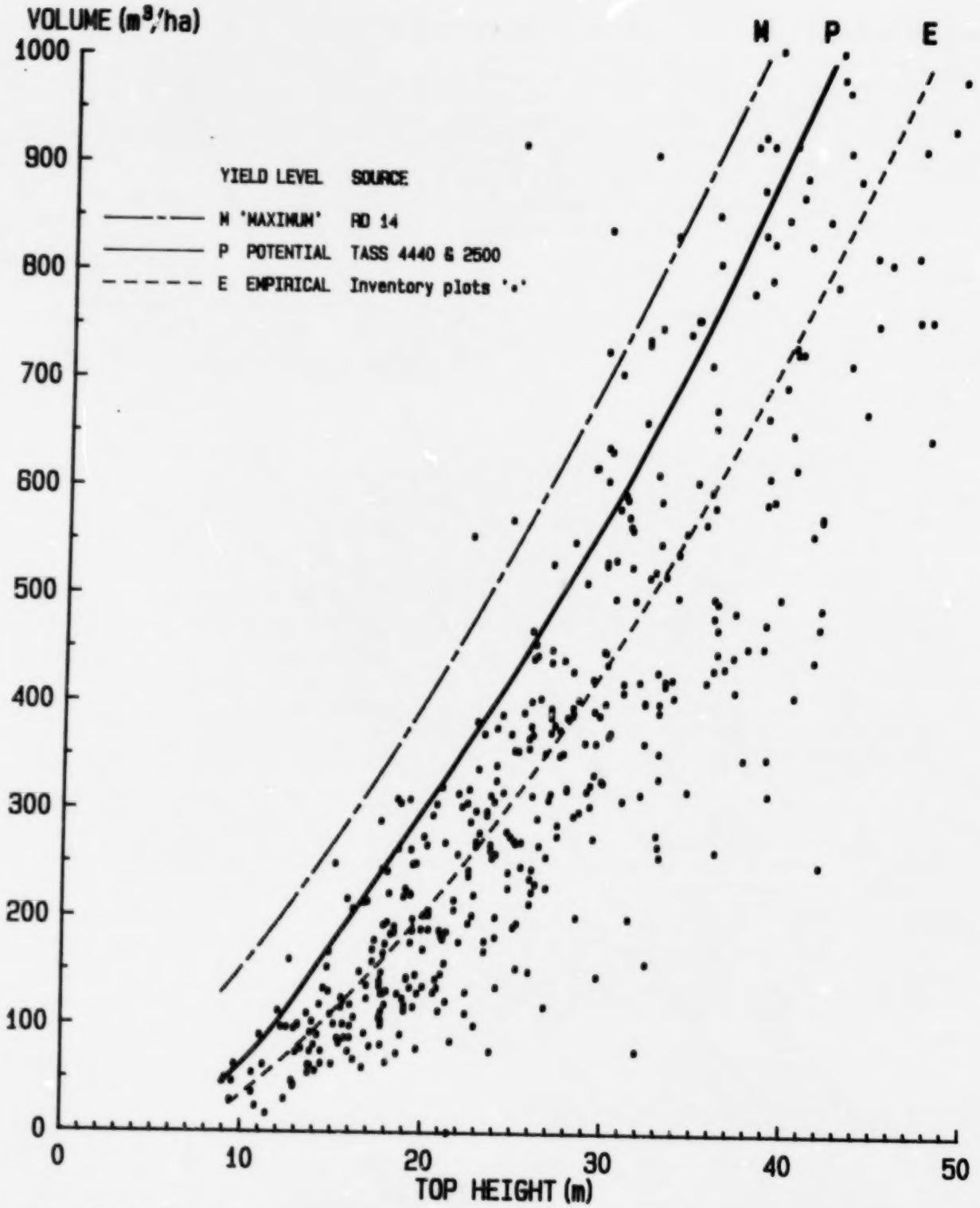


FIGURE 7. Comparison of volume/height relationships from randomly located temporary plots, TASS, and Relative Density 14 (Curtis 1982).

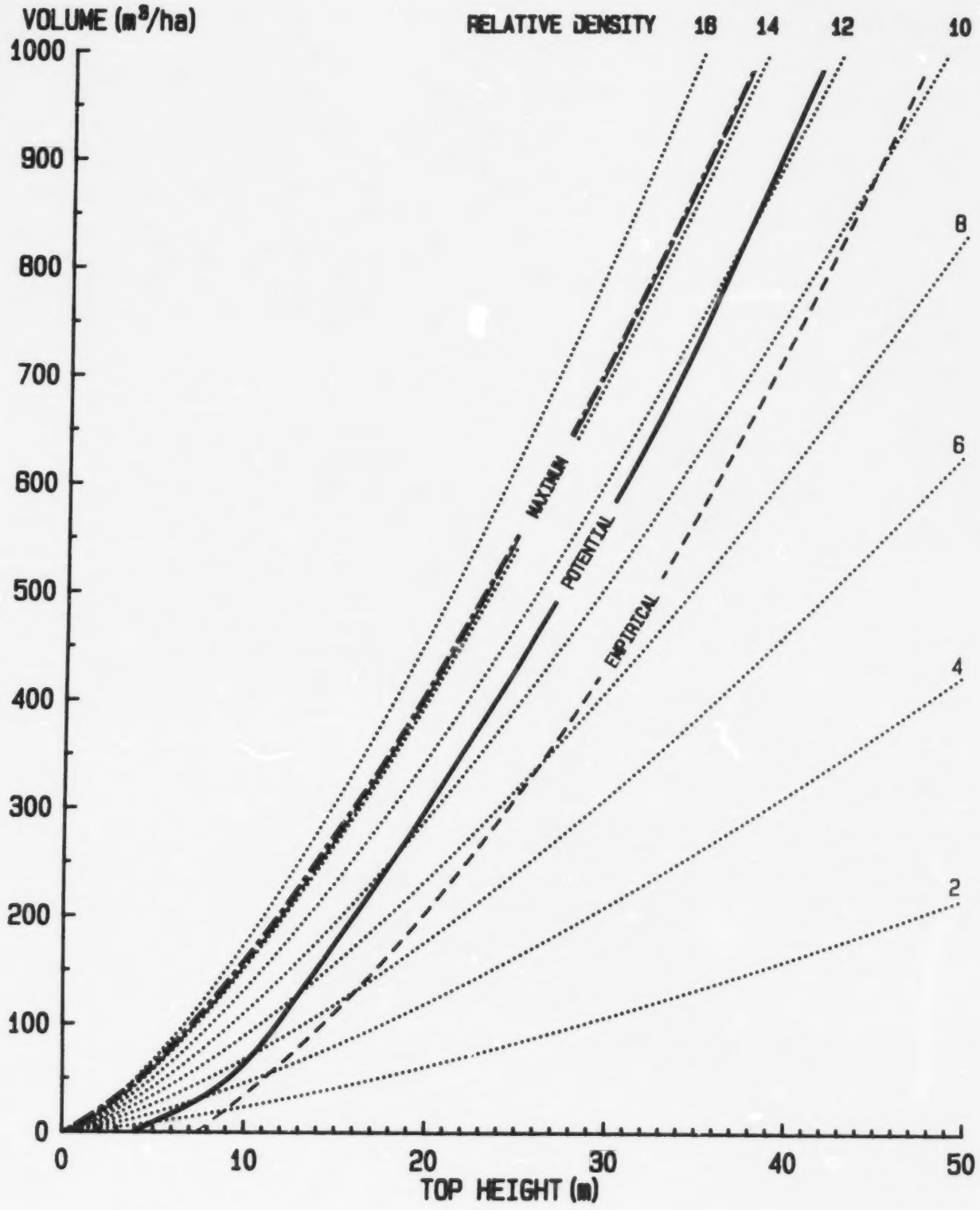


FIGURE 8. Maximum, potential, and empirical levels of yield superimposed on relative density classes.

Construction

TASS simulated each of the 11 treatments in Table 1 by growing 50–580 trees (300–4440 per hectare) in 0.13- to 0.16-ha plots. The simulation progressed from age 0 to 150 on site 35. Approximately 50 trees (300 per hectare) survived, regardless of initial density, due to the differential impact of mortality. Leave trees in thinned stands were identified on crown maps at age 14 (site height = 6 m) with the aid of lists that ranked trees in decreasing order of height and diameter. To favour uniform spacing, vigorous trees with large crowns and stems replaced some of the tallest trees selected in the first pass. The largest 250 stems per hectare living at age 150 were identified in retrospect as having been the prime crop trees throughout the life of the stand.

The simulated data for volume and other variables in the yield tables were graphed against site height and fitted with a free-hand curve to remove minor irregularities caused by mortality, particularly towards the end of the run when each dead tree removed 1-2% of the plot volume. The yield table entries for each variable (volume, basal area, diameter, stem count, crown cover, and crop-tree statistics) were read in 3-m steps of height from the appropriate curve. The number of stems and merchantable volumes were summarized by 5-cm diameter classes in stand and stock tables, starting at 12 m of height and continuing to 48 m in 9-m steps. This information was not graphed and smoothed across the range of diameter or height classes. Mean annual increment was plotted over total age for each site class and merchantability limit, and then smoothed to determine the culmination age and corresponding increment.

Application

Table 2*a* illustrates an abridged yield table for a stand planted with 2500 trees per hectare which has remained untreated. All yields are related to a standardized reference height which will be explained later. The table of cumulative production shows that a 39-m tall stand will have a gross production of 1039 m^3/ha (standing volume plus accumulated mortality), and a total standing volume (all living trees exceeding a diameter of 0.0 cm or 7.5 cm) of 866 m^3/ha. Exclusion of 30-cm stumps, 10-cm tops, and trees below 12.5 cm would leave a merchantable volume of 826 m^3/ha. Volumes for other diameter limits are given, in addition to the basal area (64.9 m^2/ha), mean DBH (33.3 cm), stem count (746 per hectare), and crown cover (100%). Crop-tree statistics are replaced by age-site information in Table 2 for clarity. This 39-m tall stand would be 48 years old on site class I (good site; 40 m at bh age 50); 60 years on site II; 82 years on site III (medium); and 134 years on site IV. Either the "years to breast height" given below the breast-height ages, or local information, can be used to calculate total age. The stand and stock tables in the second section of Table 2*a* shows that the 746 trees in the 39-m tall stand range in diameter from 15- to 55-cm, with most falling in the 30- to 35-cm diameter classes. The distribution of merchantable volume (826 m^3) is similar. The maximum mean annual increment (MAI) is given in the third section for Table 2*a* for different minimum DBH limits. The MAI of trees 17.5 cm + will culminate at 15.3 m^3/ha in 60 years on site 40, but will only attain 9.1 m^3 after 85 years on site 30. Yields at these ages are given later in the unabridged tables which include heights to 57 m.

The yield table in Table 2*b* shows the impact of thinning the previous stand to 1110 trees when it is 6 m tall. Notice that the merchantable volume (12.5 cm +) at 39 m increases from 826 to 847 m because of treatment.

The relationship of stem count, diameter, and volume to height, as provided by the preceding tables, is portrayed graphically in Figure 9. The lowest graph shows site curves based on information from the right-hand side of the cumulative production tables (Table 2). Assume that yield predictions for untreated (2500) and thinned (2500–1110) stands growing on site 35 are needed for bh ages 20, 40, and 60 (total ages 28, 48, and 68). Locate the appropriate ages and site on the lowest graph, and follow each arrow to obtain the corresponding height, volume, diameter, and stem count on each series of graphs. The apparent gain in diameter at 40 years associated with thinning is about 3 cm. However, the number of trees is different in the two populations. It would be more meaningful to compare the diameters of the largest 250 trees per hectare. Yields can also be read directly from Table 2 for ages 20 and 60, and interpolated for age 40. The results for site 35 are summarized below:

AGE at bh	20		40		60	
	Untreated	Thinned	Untreated	Thinned	Untreated	Thinned
Ref. height	18.0	18.0	30.4	30.4	39.0	39.0
Volume (7.5 +)	239	202	572	578	866	896
Diameter	14.2	18.3	23.5	26.5	33.3	34.4
Stem count	2199	1072	1263	982	746	735

TABLE 2. Abridged yield tables for (a) untreated and (b) thinned stands planted with 2500 trees/ha.

a. Stand planted with 2500 trees/ha — untreated

Cumulative production

REF. HEIGHT (m)	VOLUME (m^3/ha)								BASAL AREA (m^2/ha)	MEAN DBHg (cm)	STEM COUNT (/ha)	CROWN COVER (%)	BREAST-HEIGHT SITE INDEX (m)			
	Gross Prod'n	Total Standing		Merchantable									40 (I)	35 (II)	30 (III)	25 (IV)
	0.0+	0.0+	7.5+	12.5+	17.5+	22.5+	27.5+	32.5+					AGE @ breast height			
0	0	0	0	0	0	0	0	0	0.0	0.0	2500	0	—	—	—	—
6	13	13	0	0	0	0	0	0	4.9	5.2	2310	88	6	6	7	8
18	243	240	239	161	75	3	0	0	34.6	14.2	2199	100	18	20	24	30
21	324	320	319	242	159	22	5	0	40.8	15.4	2184	100	21	25	30	38
24	**407**	**400**	**400**	**324**	**248**	**84**	**9**	**3**	**45.6**	**16.9**	**2024**	**100**	**25**	**29**	**35**	**47**
27	**509**	**481**	**481**	**412**	**357**	**230**	**46**	**9**	**50.0**	**19.6**	**1657**	**100**	**29**	**34**	**42**	**57**
30	**618**	**559**	**559**	**509**	**470**	**380**	**186**	**26**	**54.0**	**23.0**	**1299**	**100**	**33**	**39**	**50**	**70**
33	746	649	649	606	587	537	364	124	57.5	26.4	1050	100	37	46	59	86
36	889	757	757	716	712	682	569	337	61.0	29.9	870	100	42	52	70	107
➡ 39	1039	866	866	826	825	810	755	559	64.9	33.3	746	100	48	60	82	134
										Years to Breast Height			7	8	8	9

Stand and stock tables (2.5+)

REF. HEIGHT (m)	STEM COUNT (/ha)	MERCH. VOL. (m^3/ha)	DIAMETER CLASSES (cm)													
			5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
21	**2184**		**96**	**598**	**848**	**586**	**49**	**7**									
		250		***8***	***83***	***137***	***17***	***5***									
30	1299			6	289	325	425	232	15	5	2						
		509			*39*	*80*	*204*	*160*	*14*	*8*	*4*						
➡ **39**	**746**				**7**	**35**	**94**	**230**	**237**	**110**	**26**	**5**	**2**				
		826			***1***	***15***	***55***	***198***	***297***	***180***	***58***	***16***	***8***				

Maximum mean annual increment (m^3/ha) and culmination age (years: total age)

DBH LIMIT (cm)	SITE INDEX							
	40		35		30		25	
	MAX. MAI	CULM'N AGE	MAX. MAI	CULM'N AGE	MAX. MAI	CULM'N AGE	MAX. MAI	CULM'N AGE
➡ **17.5+**	**15.3**	**80**	**12.3**	**72**	**9.1**	**85**	**6.2**	**100**
22.5+	15.3	61	12.2	75	8.9	91	5.9	118

b. Stand planted with 2500 trees/ha — precommercially thinned to 1110

Cumulative production

REF. HEIGHT (m)	VOLUME (m^3/ha)								BASAL AREA (m^2/ha)	MEAN DBHg (cm)	STEM COUNT (/ha)	CROWN COVER (%)	BREAST-HEIGHT SITE INDEX (m)			
	Gross Prod'n	Total Standing		Merchantable									40 (I)	35 (II)	30 (III)	25 (IV)
	0.0+	0.0+	7.5+	12.5+	17.5+	22.5+	27.5+	32.5+					AGE @ breast height			
(6)	(13)	(8)	(0)	(0)	(0)	(0)	(0)	(0)	(2.8)	(5.7)	(1110)	(53)	6	6	7	8
18	210	202	202	170	130	13	3	0	28.2	18.3	1072	100	18	20	24	30
21	285	277	277	244	220	75	5	0	33.9	20.1	1072	100	21	25	30	38
24	**369**	**361**	**361**	**325**	**309**	**172**	**19**	**7**	**39.9**	**21.8**	**1065**	**100**	**25**	**29**	**35**	**47**
27	**466**	**456**	**456**	**416**	**404**	**316**	**104**	**9**	**46.0**	**23.8**	**1038**	**100**	**29**	**34**	**42**	**57**
30	**577**	**562**	**562**	**520**	**515**	**484**	**278**	**50**	**53.0**	**26.2**	**991**	**100**	**33**	**39**	**50**	**70**
33	707	672	672	637	635	597	463	220	58.9	28.6	927	100	37	46	59	86
36	851	791	791	754	754	740	657	430	64.5	31.4	837	100	42	52	70	107
➡ 39	1009	896	896	847	847	843	812	629	68.4	34.4	735	100	48	60	82	134
										Years to Breast Height			7	8	8	9

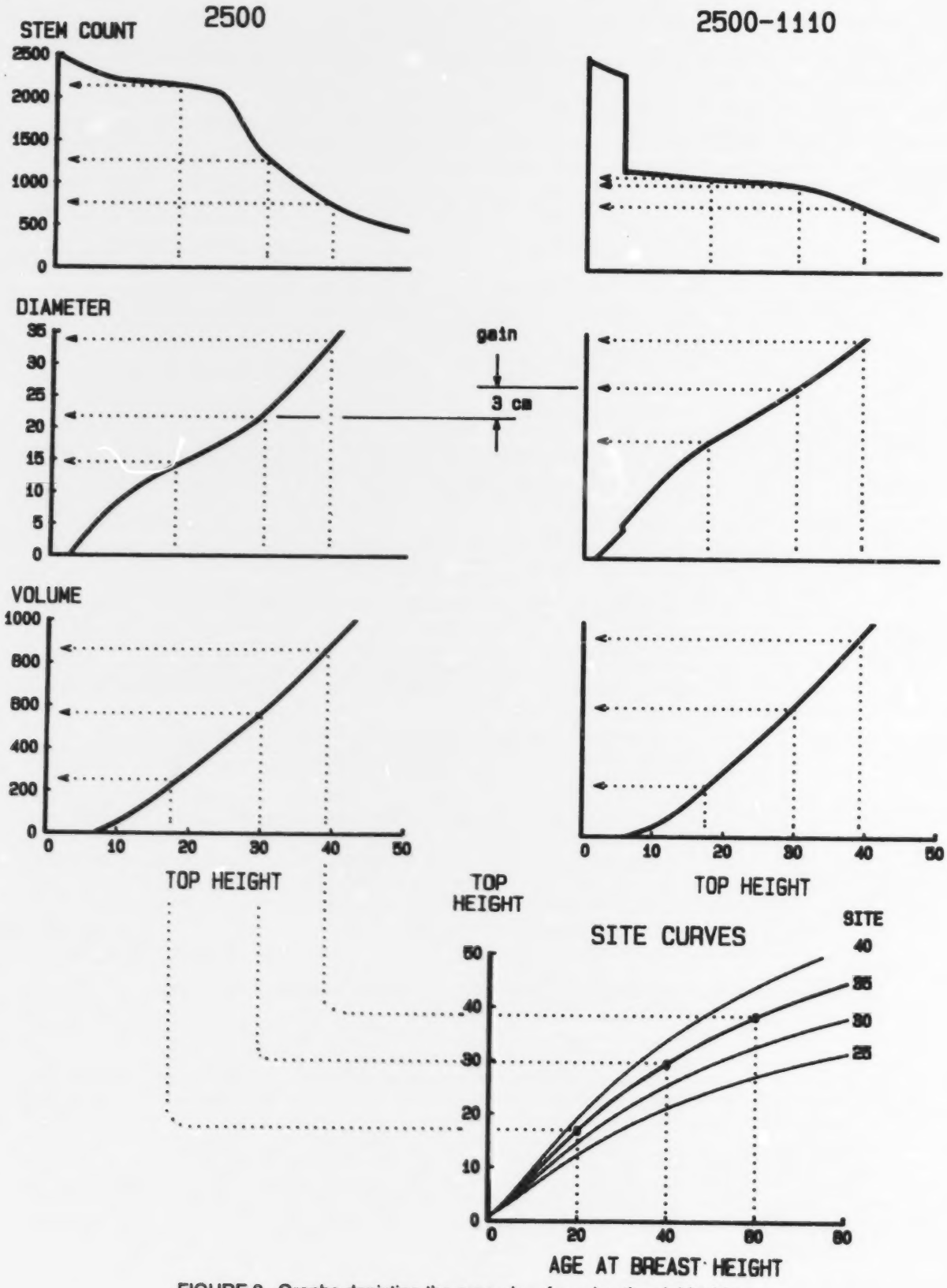


FIGURE 9. Graphs depicting the procedure for using the yield tables.

The unabridged site index tables (Tables A-1 and A-2), managed stand yield tables (Tables A-3 — 15), and supporting graphs (Figures A-1 — 22) are consolidated in the Appendix for convenience when referencing and applying the information. The tables are similar to those in Table 2, except that height is extended (0, 3, 6, . . ., 57 m), crop-tree statistics are added, and a foldout page (Table A-2) expands the age information to cover 23- to 45-m sites in 1-m steps. Table A-2 is derived from the site index equation developed by Bruce (1981). The equation precedes the site table (Table A-1) and site curves (Figure A-1) in the Appendix. The yield of stands established with 4440 trees per hectare is shown in Table A-3. Open the attached foldout (Table A-2) to view both tables and the supporting graph of volume over age (Figure A-2). The derivation of this graph is described below to illustrate the application of yield tables, A-3 — 13. These tables are summarized in Table A-15, and follow a comparison of different parameters of height (Table A-14). Note that a glossary of terms appears on the foldout page below Table A-2.

Assume that a graph of merchantable volume (22.5 +) over total age is needed to determine the mean annual increment and age at which it culminates on site 30. The 9th column of Table A-2 gives bh ages for site 30 corresponding to the entries for merchantable volume (22.5 +) in the 7th column of Table A-3.1. However, before the curve is plotted in Figure A-2, the "years to breast height" below column 9 of Table A-2 must be added to each entry to give total age. The volume of 705 m^3/ha, for example, is attained at age 78 which is the sum of the age at breast height (70 years) and the age correction (8 years) given for site 30. A line drawn through the origin of Figure A-2 will be tangent to the curve for site 30 at a point directly above age 90 (82 years at bh), corresponding to a height of 39 m (Table A-2, column 1), a volume of 845 m^3/ha (Table A-3.1), and a mean annual increment of 9.4 m^3/ha (845/90). This is very close to the increment (9.4 m^3) and age (88 years) given in Table A-3.3 for site 30 and a diameter limit of 22.5 cm.

Table A-3.1 shows that the 250 crop trees in a 39-m stand will have a volume of 432 m^3/ha (column 14) and an average diameter of 40.1 cm (column 15), which is considerably above the 34.0 cm shown for the entire stand. Most crop trees will be in the 40- and 45-cm diameter classes, while the remainder of the harvestable trees will range in diameter from 25 to 35 cm (Table A-3.2).

Frequently, yield tables must be adapted to special situations before they can be applied. Adjustments for operational falldown were discussed earlier under the topic of yield levels. Currently, the B.C. Ministry of Forests reduces the volumes in these tables by 15% in preparation for timber supply analyses. This reduction compensates for incomplete site occupation, pests, and other factors not usually encountered in research plots. Diameters are not altered. In addition, the volumes and diameters in stands established with 4440 trees (Table A-3) are arbitrarily scaled down by factors of 0.90 and 0.95, respectively (0.95 and 0.975 in Table A-6 with 2500 planted trees), in recognition of the impact that high density can have on the height growth of site trees. As discussed earlier, this process of repression or stagnation will be incorporated into TASS — if warranted — when more information becomes available.

In conclusion, there are situations in which the application of yield tables is appropriate and others in which it is not. The tables are designed to provide information vital to the planning process, particularly the impact of establishment density on yield. However, a myriad other factors must be considered. These might include regeneration delay, planting costs, survival, natural fill-in, irregular mortality, size-price gradients, and aesthetics. The yield tables are not intended to evaluate the performance of individual plots, or to estimate their future yield. For example, the measured volume of an 18-m tall plot located in a stand planted with 2500 trees may differ from that given in Table A-6 (240 m^3/ha) by 50 m^3. This is not unexpected considering the variation in volume relative to height displayed by comparable spacing trials (Figure 2*e*). Consequently, the yield tables represent an average condition or category of stands — not individual plots measured in the field.

Interpretation

The following discussion emphasizes the interpretation of the yield relationships in Tables A-3 — 15 and Figures A-1 — 22 within the context of the dynamics of stands.

Initial Density

Process-oriented models such as TASS occasionally generate yield relationships that are not anticipated, but still quite plausible. The impact of initial density on top height is a thought provoking example. Variation in the height growth of free-growing trees in young stands is obvious and an essential component of TASS. An earlier study in plantations with 3000 stems per hectare showed that the tallest 100 trees per hectare grew 20% faster than the average tree (Mitchell 1975*a*). Competition for growing space had not reduced the height growth of any trees prior to measurement. In a hypothetical stand with only 100 trees per hectare, the height of the tallest 100 trees will be equal to the average height (i.e., 20% shorter than the stand with 3000 trees). Because the height of the 100 trees of largest diameter (top height) is close to the height of the tallest 100 trees, it becomes apparent

that top height may be affected by the initial density of the stand. In other words, the opportunity for selecting a fixed number of vigorous trees is enhanced by population size. The magnitude of this unsubstantiated phenomenon is shown below for simulated stands of various initial densities growing on site 35:

	Initial density (trees/ha)		
	500	1110	4440
Age at bh	Top height		
20	16.3	17.1	18.0
40	28.1	29.6	31.0
60	35.4	37.2	39.0
80	40.8	42.9	45.0

At age 80, stands planted with 1110 trees are about 2 m taller than those established with 500. The additional 2 m which separate the regimes with 1110 and 4440 trees must be viewed cautiously, as TASS does not simulate repression. The different height-age relationships indicate that site index will vary in response to initial density. This apparent variation in site quality should be interpreted as a change in site utilization in the same way that genetic selection can alter height growth, site index, and yield.

The effect of initial density on the repression of height growth became apparent at Wind River, Wash., after the spacing trials reached an age of 29 years and a height of about 15 m (Reukema 1979). By age 53, top height decreased from about 30 m in stands planted with 1110 trees per hectare (10-ft spacing), or fewer, to 19 m at a density of 6700 (4-ft spacing). Repression has not been observed in the spacing trials — all approximately 20 m tall — at two locations on Vancouver Island (E.P. 571, Figure 2); the University of British Columbia Research Forest[10], or Champenoux, France (Oswald and Pardé 1976). Note that the site index at Wind River (32 m) is considerably lower than at other locations (EP 571 = 36 and 42 m, Research Forest = 45 m, and Champenoux = 40 m). Consequently, the magnitude and geographic extent of repression, and its relationship to stand parameters and environmental factors, will not be known for some time.

Each variable in Tables A-3.1 — 14.1 is discussed in the remainder of this section in relation to the impact of initial density on yield.

Reference height, the first variable in each table, aligns the yield data (Tables A-3.1 — 14.1) with the age and site information in the foldout (Table A-2). The sequence of entries (0,3,6,. . ., 57 m) is the same in all tables. It also facilitates the comparison of yields across the range of initial densities (Figures A-13, A-14, and A-16 — 20). These comparisons include the variation in site quality associated with initial density discussed above. The impact of genetic upgrading can be removed by plotting volume, or any other variable, against top height rather than reference height. Top height and mean height are given in Table A-14 rather than Tables A-3.1 — 13.1 to facilitate the following explanation of each measure of height.

Top height (Table A-14), the average height of the 100 trees per hectare of largest diameter, is commonly used to compare tabular yields with data from permanent sample plots, particularly during calibration as illustrated in Figures 2 and 6. Note that top height and reference height are identical when 4440 trees are established. This level of stocking is arbitrarily assumed to represent the highest degree of site utilization. Table A-14 shows that top height declines across the regimes as discussed earlier. Notice that stands established with 4440 trees and thinned to 500, for example, are 1 m behind the 45 m of top height achieved by their unthinned counterparts because thinning removed a few candidate site trees to promote uniform spacing.

Mean height (Table A-14) is always less than top height because it is derived from the entire population rather than from the 100 largest trees per hectare. At 3 m of reference height, the average tree in the densest stand (4440: refer to column 3) achieves 2.4 m or 80% of top height. However, greater mortality of smaller trees in the following interval elevates the ratio of mean height to top height (4.9/6.0 = 0.82). Intense competition for growing space and suppression of the height growth of crowded trees of relatively low vigour later impairs the height development of many trees without causing appreciable mortality. The ratio declines to 0.63 at a top height of 18 m, but the onset of suppression mortality of the shortest trees prompts it to increase rapidly to 0.82 at 30 m and 0.90 at 39 m. The changes in mean height relative to top height decrease along with initial density and disappear at the lowest level (300 trees per hectare).

Gross volume production (Tables A-3.1 — 13.1) records the accumulated stemwood production. It includes mortality and other removals. The neatly ordered family of curves in Figure A-13 shows that initial density strongly influences the relationship between gross volume production and reference height. The largest

[10] J.H.G. Smith. 1983. Ibid.

population of trees (4440) is able to occupy and use the growing space quickly, in terms of crown cover (crown cover, Figure A-18), relative to widely spaced plantations. The lost production is irretrievable, thus creating a permanent difference between adjacent curves. If all the populations were equally vigorous, this difference in total production would persist indefinitely after the distribution of crown sizes and mortality stabilize. However, the population of simulated trees that survives intense competition in dense stands is taller and more vigorous than its counterpart in stands of lower initial density. Notice that the 353 surviving trees in the last entry under stem count (Table A-3.1) account for only 8% of the original population of 4440 trees (stem count, Figure A-18), as opposed to the 46% that emerged from the population with 750 trees (Table A-11). This process accelerates the later growth of the dense stands and forces the curves to diverge slightly once the sites have reached their carrying capacity.

Please keep in mind that the simulated upgrading of vigour has not been confirmed by field trials. As a reminder, most yield relationships for stands established with 4440 trees per hectare are depicted by broken lines in Figures A-13 — 20.

Total standing volume (0.0 +) in Figure A-14 is identical to gross production until depressed by mortality which begins early in overstocked stands and progressively later in widely spaced plantations (Figure A-18). The standing volume of the densest stand (4440 trees) declines dramatically, relative to total production, beyond 24 m of height (Table A-3.1) when many trees die of suppression. Plantations established with only 300 trees are virtually unchanged because mortality is negligible. Consequently, standing volume curves tend to merge in a sequence related to initial density (Figure A-14). The exclusion of trees with diameters below 7.5 cm (Tables A-3.1 — 13.1, column 4) has little impact on volume, particularly at wider spacings. This diameter limit, like specifications for merchantable volume, conform with the Ministry's inventory standards.

Merchantable volume growing in plantations established with 2500 stems is illustrated in Figure A-15 along with the gross production and standing volume, and embedded mortality. The successively lower curves show reductions in volume due to the exclusion of stumps, tops, and unmerchantable trees with diameters below 12.5, 17.5, 22.5, 27.5, and 32.5 cm. Note that the merchantable volume curves merge as the smallest trees die or grow beyond a particular diameter limit. The relatively rapid diameter growth in widely spaced plantations (e.g., 500 in Table A-12.1 vs. 2500 in Table A-6.1) shortens the period needed to achieve merchantable dimensions, thus creating a more compact family of curves by elevating the lower members. The impact of age and site on merchantable volume (22.5 +) is illustrated in Figures A-2 — 12 to the right of each yield table in the Appendix. Lowering the site quality reduces yield and increases the age at which the mean annual increment (MAI) culminates. Treating stands to achieve wide spacing also tends to increase the culmination age (Tables A-3.3 — 13.3). Stands planted or respaced to 500 trees usually cuiminate 5 to 10 years later than denser stands. Plantations with 300 trees culminate much later.

Basal area and volume exhibit similar patterns of development except that differences in basal area are more pronounced across the range of treatments because the death of suppressed trees has more impact on basal area than on volume (Figure A-16). Notice that the late onset of mortality in widely spaced plantations (e.g. 750 trees) apparently allows the basal area to exceed that of the denser stands. However, the dynamics of stand development are more complex. Consider the stands established with 4440 (1.5 × 1.5 m) and 1110 (3.0 × 3.0 m) trees. The 4440-stand occupies the growing space quickly and yields more wood until heavy mortality, beginning at 15 m of height, diminishes the advantage of close spacing. The initial inefficiency of widely spaced stands is overcome by 18 m of height (Table A-9.1) when large crowns occupy the entire plot and concentrate the growth on relatively few stems. The rate of volume and basal area growth is similar in both stands at this point, but the high mortality in the 4440-stand leaves the 1110-plantation with greater net basal area beyond 36 m of height as the stem count converges to about 850 trees (Figure A-18). Trees in the 1110-stand have slightly larger diameters (34.0 vs. 34.5 cm at 39 m) as a result of their relatively large crowns in earlier years, and must have more basal area per hectare since there are 729 stems per hectare in both stands (Table A-3.1 and A-9.1). However, the volume produced by the 4440-stand is consistently higher (Figure A-14) because of better form and vigour. The dynamics of crown competition are similar after 39 m, resulting in approximately the same number of trees dying annually in each plot. However, the boles of trees that die in stands of lower initial density (i.e., 1110) are relatively large and have a greater negative impact on the yield. Differential mortality of basal area forces the curves to converge slowly with increasing height. The curves cross again at 60 m of height (not shown) because the trees that survived the intense selection pressure in the 4440 stand are of superior vigour, and are capable of outstripping the production of the 3-m plantation. In summary, wide spacing effectively "captures" some of the mortality of dense stands and stores it as wood in living trees until it can be harvested. This manipulation of the growing stock allows plantations of comparatively low density (e.g. 1110 trees, Figure A-14) to achieve volumes similar to denser stands, while producing trees of greater average diameter (Figure A-17). Theoretically, the basal area (Figure A-16) of widely spaced stands (300 trees per hectare) will surpass the production of dense stands if given enough time. The magnitude of this phenomenon will not be known until spacing trials generate the information needed to improve the accuracy of models and yield predictions.

Mean DBHg (Figure A-17) reflects the length of the period prior to canopy closure when the development of the crowns and stems is unrestricted by inter-tree competition. Note that the occurrence of 95% crown coverage varies from 6 to 27 m of height across the range of densities (crown cover, Figure A-18). The separation of the diameter curves remains fairly constant after mortality reduces the number of trees to a common level (stem count, Figure A-18). Thereafter, the distribution of heights and crown dimensions is similar in all stands. Each population grows at roughly the same rate, and differences in bole dimensions are largely due to past growing conditions. That is, trees originating in widely spaced stands have larger crowns for a longer period, allowing them to intercept and assimilate more resources.

Stem count, prior to crown closure, decreases in response to seedling vigour, microsite limitations, inclement weather, pest damage, and other sources of mortality that become less potent as the trees increase in height (Figure A-18). The relationship between the density of the stand and the rate of mortality is based on the performance of spacing trials in the Pacific Northwest. Mortality accelerates rapidly following canopy closure, as the crowns of the vigorous trees increase their share of the finite resources at the expense of weaker trees that must relinquish growing space and eventually die of suppression. The stem counts appear to merge in spite of differences in initial density, once the dynamics of crown competition, social structure, and rate of mortality become similar in all stands.

Crown cover is controlled by the number of trees and their spatial distribution. The latter is of little consequence in Figure A-18 because square spacing is employed in all but the densest stand. Mortality before canopy closure can create large holes that delay complete crown cover, particularly in widely spaced plantations. The stand with 300 trees per hectare, for example, achieved 90% occupancy at a height of 21 m, but did not fully close until 45 m because of 12 large holes created by mortality at an early stage of development.

Crop trees of relatively large size account for most of the revenue generated by a stand because of lower harvesting and processing costs per unit, and higher product value. Statistics based on the 250 trees per hectare of largest diameter (12.5 +) are included in the yield tables to show the impact of management on this important component of the stand. The trees in this select group were identified at the end of each simulation and traced back through time to determine past volume, diameter, and crown dimensions. Note that crop trees only account for about 40–60% of the harvestable trees at 42 m of height in stands established with 500 or more trees per hectare (Tables A-3 — 12).

Merchantable volume (crop trees) increases in response to wide initial spacing in the range of 2500-300 stems per hectare (Figure A-19), in contrast to the merchantable volume of the entire plantation which declines from 931 to 630 m^3 ha across these regimes at 42 m of height (column 5, Tables A-6.1 vs. 13.1). Crop trees in widely spaced stands have more growing space, larger crowns, and greater volume increment. This advantage gives stands planted with 500 trees about 15% more crop-tree volume, at 42 m of height, than those established with 1110 trees. The dense natural stand (shown by the broken line in Figure A-19) behaves differently because there is a greatly improved opportunity for 250 crop trees of superior vigour to be selected from a population of 4440 trees.

Mean DBHg (crop trees), like volume, is stimulated by wide spacing (mean DBHg, Figure A-20). The 500-tree regime exceeds the 1110-tree regime by 12 and 25% in terms of diameter and basal area, respectively, at 42 m of height. However, the gain in basal area only generates a corresponding increase in volume of 14% because the crop trees in the stand of low density are 2 m shorter, and have a lower form factor (0.38 vs. 0.40).

Live crown percent (crop trees) expresses crown size that reflects establishment density and growing space available to the crop trees as they mature (live crown %, Figure A-20). These trees capitalize on this advantage, which tends to diminish as mortality reduces the differences in the density across the treatments. Note that trees in stands with 500 trees have much longer crowns at 15 m than comparable crop trees in stands with 2500 trees (72 vs. 52%). However, the advantage decreases considerable by 42 m of height (29 vs. 22%).

Precommercial thinning density

The total volume (0.0 +) of thinned stands is depressed in the period following treatment when the site is not fully occupied. However, it eventually surpasses the volume of the untreated forest as demonstrated by the plantation established with 2500 trees (Figure A-21). Precommercial thinning to wider spacing magnifies the depression of volume early in the rotation, and delays its recovery while accentuating the rebound later in the life of the stand. The yield relationships are very similar to those discussed earlier in the context of initial density, except that respacing allows the manager to reap several benefits simultaneously. That is, the average vigour of the population is upgraded artificially through thinning, and more growing space is available to individual trees. The development of diameter in thinned stands planted with 2500 trees is shown in Figure A-22. A residual density of 750 is added for comparison even though no yield table was prepared for this treatment level.

Although these tables do not address the timing of precommercial thinning, it is apparent from other simulated experiments that the treatment has the greatest impact on yield when undertaken before the onset of mortality following crown closure. Respacing at a later stage tends to create larger holes that are reoccupied at a relatively slow rate because the invading branches near the base of longer crowns grow slowly. Consequently, the response and culmination age can be delayed appreciably.

Management Scenarios

The following hypothetical examples illustrate procedures for interpreting the information in the yield tables.

Over the past 40 years, the number of trees planted has decreased from about 2500 to a lower limit of 500 per hectare. What foresters have achieved, other than a reduction in planting costs, can be appreciated by comparing stands planted with 2500 trees (Table A-6) and 500 trees (Table A-12). Yields at 39 m of height on site 30 are summarized on lines 1 and 2 below:

	Regime	Yield table	Reference height	Volume (12.5+)	Mean DBHg	Stem count	Crop trees Vol.	Crop trees DBHg
1.	2500	A-7	39	826	33.3	746	402	39.3
2.	500	A-13	39	684	43.2	427	488	46.8
3.	2500-500	A-9	39	807	41.8	487	501	45.6

The stands will be 82 years old at breast height (Table A-2) which equates to a total age of 90 years. The merchantable volume (12.5+) of the stand declines from 826 to 684 m^3. However, the remaining statistics improve considerably. The volume and diameter of the crop trees, for example, increase by 86 m^3 and 7.5 cm, respectively. Few large trees are grown instead of many small ones. A comparison of the stock tables (Tables A-6.2 and A-12.2) suggests that 483 m^3/ha of wood contained in trees below 42.5 cm DBH (mostly 30-35 cm) will be exchanged for 341 m^3 in larger trees (mostly 45-50 cm DBH).

A related scenario provides the option of planting 500 trees, or planting 2500 per hectare and later thinning the stand to the target density. The statistics given with the preceding example (lines 2 and 3) show that the thinned stand produces 807 m^3, which exceeds the alternative by 123 m^3. However, this advantage is not apparent in the other stand and crop-tree statistics because the improved vigour is offset by the vagaries of the spatial distribution of the thinned stand. In summary, respacing to 500 trees — as opposed to planting 500 trees — increases the volume but leaves the average diameter and rotation length (Tables A-8.3 and A-12.3) unchanged. The expected yield will influence the choice of a management regime. However, cost of planting and thinning, size and value of products, and other factors are also important, as is illustrated in the following scenarios.

The previous example examined two methods of achieving a growing stock of 500 trees, when planting bare ground. The manager may also have to decide if existing plantations with 2500 trees should be thinned to 500 stems. The projected volumes (826 vs. 807 m^3) are similar (lines 1 and 3 above). However, the average diameter of the thinned stand will be increased by 8.5 cm; larger crop trees of relatively high volume and value will be harvested; and 259 fewer trees will be handled and processed. Thinning has effectively moved about 450 m^3 of wood from the 35-cm diameter class and below to the higher diameters classes centred around 45 cm. The regime of greatest interest will depend on the economic ramifications of the alternative strategies.

The manager can also look to the yield tables for regimes that match particular milling facilities or markets while maximizing yield. For example: which regime will produce an average diameter of 45 cm coincident with the culmination of mean annual increment on site 35? In each table locate the diameter nearest 45 cm and its associated height (Tables A-3.1 — 13.1), obtain the corresponding age for site 35 (Table A-2), and compare this age with the age of maximum mean annual increment for trees 12.5 cm and larger (Tables A-3.3 — 13.3). The pertinent information for unthinned stands is summarized below:

Regime	Entire stand					250 Crop trees			
	Mean DBHg	Ref. height	Age bh	Age Total	MAI	Mean DBHg	Ref. height	Age bh	Age Total
1110	44.8	48	92	100	71	44.5	42	69	77
750	46.5	48	92	100	**75**	**46.4**	42	69	**77**
500	**46.0**	42	69	**77**	**82**	43.7	36	52	60
300	46.4	36	52	60	100	43.2	33	46	54

Planting 500 trees produces an average diameter of 46.0 cm in 77 years, which is near the rotation age of 82 years given in the MAI column. If only the crop trees are of interest, 750 trees should be planted. They will reach 45 cm shortly before age 77 (actually at age 73) which is close to the culmination age of 75 years. A similar analysis shows that stands thinned to 500 stems also reach an average stand diameter of about 45 cm when the mean annual increment culminates. Lowering the site index to 25 m reduces the recommended density to 300 trees. About 600 trees would be appropriate on site 40. Decreasing the target diameter to 35 cm on site 35 increases the optimum initial density to 1110 trees or more.

A forester interested in commercial thinning opportunities may plan to harvest a minimum volume of 200 m^3, consisting of trees (12.5+) having an average diameter of at least 22.5 cm, and to leave about 350 crop trees. The stand and stock tables contain the relevant information. Consider the distribution of stem counts and merchantable volumes at 30 m of height in stands planted with 1110 trees. The information is summarized below:

	Product destination					
	Waste	Thinnings		Final harvest		
Diameter classes (cm)	15	20	25	30	35	40
Stem count (/ha)	40	190	375	230	99	20
Merch. volume (m^3/ha)	4	46	164	157	89	23
Weighted diameter (cm)	15	**22.8**			32.0	
Stem count (/ha)	40	565			**349**	
Volume (m^3/ha)	4	**210**			269	

Note that the first three lines are copied from Table A-9.2. The average weighted diameter of stems in the 20- to 25- cm classes is 22.8 cm. Harvesting these trees would allow the forester to realize a volume of 210 m^3, while leaving 349 trees to be carried to harvest age. Denser stands spaced to 1110 trees (Tables A-4.2 and A-7.2) also satisfy the criteria while yielding slightly more volume. Stands planted with 750 trees (Table A-11.2) are also acceptable.

Limitations

Many limitations should be kept in mind when the yield tables in the Appendix are used:

1. All yields apply to uniformly stocked stands growing in a relatively pest-free environment. The volume, basal area, and stem count should be reduced in most cases to conform with local conditions. Diameters may increase in response to understocking. Volume reductions are considered in Figure 8 and accompanying text.
2. The tables should not be applied on sites below 23 m unless confirmed by future research.
3. The phenomenon of stagnation, expressed by the repression of the height growth of site trees, is not incorporated into these tables.
4. The decline in top height associated with decreasing initial density in these tables is logical, but has not been substantiated by research trials. This is also true for many of the subtle yield relationships explained in the text.
5. Results must be interpreted cautiously when yield estimates are based on weak data such as:
   i. sites below 30 m
   ii. stands above 40 m of top height
   iii. widely spaced stands, particularly above 20 m of height. The volume data currently available are displayed in Figure 2a-d.

Future Development

Yield tables for lodgepole pine have been constructed and will be distributed soon. The format and treatments are similar to those shown for Douglas-fir.

TASS II is currently being adapted to white spruce. Yield information will be available in 1986.

A data base for coastal hemlock, *Tsuga heterophylla* (Ref.) Sarg., is now under construction, in preparation for future development of TASS.

Yield tables for fertilization, commercial thinning, and other variables of interest to managers will likely be constructed for Douglas-fir and possibly other species as resources become available.

The feasibility of incorporating wood quality and product value into TASS is being investigated in co-operation with the R. M. Kellogg (Forintek Canada Corp.), as is the possibility of linking it to a model developed by Bloomberg (1983) to simulate the spread of *Phellinus* (*Poria*) *weirii* (Murr.).

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APPENDIX

APPENDIX

Yield Tables and Graphs

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Glossary				35
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Stand established with 4440 trees/ha				
—untreated	Fd 4440	A-3	A-2	36
—precommercially thinned to 1110	Fd 4440-1110	A-4	A-3	38
—precommercially thinned to 500	Fd 4440-500	A-5	A-4	40
Stand planted with 2500 trees/ha				
—untreated	Fd 2500	A-6	A-5	42
—precommercially thinned to 1110	Fd 2500-1110	A-7	A-6	44
—precommercially thinned to 500	Fd 2500-500	A-8	A-7	46
Stand planted with 1110 trees/ha				
—untreated	Fd 1110	A-9	A-8	48
—precommercially thinned to 500	Fd 1110-500	A-10	A-9	50
Stand planted with 750 trees/ha				
—untreated	Fd 750	A-11	A-10	52
Stand planted with 500 trees/ha				
—untreated	Fd 500	A-12	A-11	54
Stand planted with 300 trees/ha				
—untreated	Fd 300	A-13	A-12	56
Reference height, top height, and mean height by treatment regime	Fd Height	A-14		58
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Merchantable volume in relation to height and initial density for stands planted with 2500 trees/ha			A-15	62
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Site Index Relationships

The Managed Stand Yield Tables (Tables A-3–14) are related to age and site by means of accurate site index relationships as explained earlier.

The height growth of Ministry of Forests' plots conforms with the site curves developed in Washington and Oregon by Weyerhaeuser Co. (King 1966) and the U.S. Forest Service (Bruce 1981). Both curves are very similar even though they employed different approaches (stem analysis vs. remeasured plots) and mathematical functions. Either may be used with the Managed Stand Yield Tables. Bruce's relationships are displayed in Tables A-1 and A-2, and Figure A-1, for convenience, because the original publication only included the equation. This system is attractive because the data come from natural and managed stands, including some in British Columbia. Furthermore, the function is fairly simple, and both top height and height-growth rate can be calculated. The metric equivalent is:

$$H = S \exp (b_2[(A + 13.25 - S/6.096)^{b3} - (63.25 - S/6.096)^{b3}])$$

$$DH = H(b_2\ b_3)\ (A + 13.25 - S/6.096)^{(b3-1)}$$

$$b_2 = 1n\ (1.372/S)/[(13.25 - S/6.096)^{b3} - (63.25 - S/6.096)^{b3}]$$

$$b_3 = -0.477\ 762 - 0.894\ 427\ (S/30.48) + 0.793\ 548\ (S/30.48)^2 - 0.171\ 666(S/30.48)^3$$

where

H = top height (m)

A = age at breast height (1.37 m, 4.5 ft)

S = site index, i.e. top height at breast-height age 50 (Bruce's equation, unlike King's, can only be solved for site index by graphical or numerical approximation)

DH = height-growth rate

Example: Solve for H at age (bh) 65 and site 37.5 to get a top height of 43.6 m. Or, enter Table A-1 (2nd page) at age 65 with field data and scan right until 43.6 m is located between entries (43.0 and 44.2) under sites 37 and 38, giving 37.5 m by interpolation.

Bruce used approximately 1500 plots from natural stands (5–80 years, 20–50 m of site index) and plantations (5–40 years, 20–42 m). The curves are probably reliable to about 135 years since they are almost identical to King's site curves which incorporate data to this age. The difference in height at 120 years is less than 0.36 m across the range of sites. Use the information beyond 135 years (Tables A-1 and A-2) with caution.

King and Bruce use the following equation to estimate the average number of years site trees require to grow from seed to breast height (Years to BH):

Years to BH = 13.25 - S/6.096 (see Tables A-1 and A-2, and Figure A-1)

Local information may be substituted. However, the earlier functions should not be altered even though the preceding equation is embedded in each.

SITE INDEX TABLE FOR COASTAL DOUGLAS-FIR

TABLE A-1. Top height by breast-height (bh) age and site (Bruce 1981)* — *Continued*

AGE @bh (years)	BREAST-HEIGHT SITE INDEX (m)															
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
	TOP HEIGHT (m)															
1	1.7	1.7	1.7	1.7	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.9	1.9	1.9	1.9	1.9
2	2.0	2.1	2.1	2.1	2.2	2.2	2.2	2.3	2.3	2.3	2.3	2.4	2.4	2.4	2.5	2.5
3	2.4	2.4	2.5	2.5	2.6	2.6	2.7	2.7	2.8	2.8	2.9	2.9	3.0	3.0	3.1	3.1
4	2.7	2.8	2.9	3.0	3.0	3.1	3.2	3.3	3.3	3.4	3.5	3.5	3.6	3.7	3.8	3.8
5	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.3	4.4	4.5
6	3.5	3.6	3.7	3.8	4.0	4.1	4.2	4.3	4.4	4.5	4.7	4.8	4.9	5.0	5.1	5.3
7	3.8	4.0	4.1	4.3	4.4	4.6	4.7	4.9	5.0	5.2	5.3	5.4	5.6	5.7	5.9	6.0
8	4.2	4.4	4.5	4.7	4.9	5.1	5.2	5.4	5.6	5.7	5.9	6.1	6.3	6.4	6.6	6.8
9	4.6	4.8	5.0	5.2	5.4	5.6	5.8	6.0	6.1	6.3	6.5	6.7	6.9	7.1	7.3	7.5
10	4.9	5.1	5.4	5.6	5.8	6.0	6.3	6.5	6.7	6.9	7.2	7.4	7.6	7.8	8.0	8.3
11	5.3	5.5	5.8	6.0	6.3	6.5	6.8	7.0	7.3	7.5	7.8	8.0	8.3	8.5	8.8	9.0
12	5.6	5.9	6.2	6.5	6.7	7.0	7.3	7.6	7.8	8.1	8.4	8.7	8.9	9.2	9.5	9.8
13	6.0	6.3	6.6	6.9	7.2	7.5	7.8	8.1	8.4	8.7	9.0	9.3	9.6	9.9	10.2	10.5
14	6.3	6.6	7.0	7.3	7.6	8.0	8.3	8.6	8.9	9.3	9.6	9.9	10.3	10.6	10.9	11.2
15	6.6	7.0	7.4	7.7	8.1	8.4	8.8	9.1	9.5	9.8	10.2	10.5	10.9	11.2	11.6	11.9
16	7.0	7.4	7.7	8.1	8.5	8.9	9.3	9.6	10.0	10.4	10.8	11.2	11.5	11.9	12.3	12.7
17	7.3	7.7	8.1	8.5	8.9	9.3	9.7	10.1	10.5	10.9	11.3	11.7	12.1	12.5	13.0	13.3
18	7.6	8.0	8.5	8.9	9.3	9.8	10.2	10.6	11.0	11.5	11.9	12.3	12.8	13.2	13.6	14.0
19	7.9	8.4	8.8	9.3	9.7	10.2	10.6	11.1	11.6	12.0	12.5	12.9	13.4	13.8	14.3	14.7
20	8.2	8.7	9.2	9.7	10.1	10.6	11.1	11.6	12.0	12.5	13.0	13.5	13.9	14.4	14.9	15.4
21	8.5	9.0	9.5	10.0	10.5	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0	15.5	16.0
22	8.8	9.3	9.9	10.4	10.9	11.4	12.0	12.5	13.0	13.5	14.0	14.6	15.1	15.6	16.1	16.6
23	9.1	9.6	10.2	10.7	11.3	11.8	12.4	12.9	13.5	14.0	14.6	15.1	15.6	16.2	16.7	17.3
24	9.4	9.9	10.5	11.1	11.6	12.2	12.8	13.4	13.9	14.5	15.1	15.6	16.2	16.7	17.3	17.9
25	9.7	10.2	10.8	11.4	12.0	12.6	13.2	13.8	14.4	15.0	15.5	16.1	16.7	17.3	17.9	18.5
26	9.9	10.5	11.1	11.8	12.4	13.0	13.6	14.2	14.8	15.4	16.0	16.6	17.2	17.8	18.4	19.0
27	10.2	10.8	11.4	12.1	12.7	13.3	14.0	14.6	15.2	15.9	16.5	17.1	17.7	18.4	19.0	19.6
28	10.4	11.1	11.7	12.4	13.0	13.7	14.3	15.0	15.6	16.3	16.9	17.6	18.2	18.9	19.5	20.2
29	10.7	11.4	12.0	12.7	13.4	14.0	14.7	15.4	16.1	16.7	17.4	18.1	18.7	19.4	20.1	20.7
30	10.9	11.6	12.3	13.0	13.7	14.4	15.1	15.8	16.5	17.1	17.8	18.5	19.2	19.9	20.6	21.3
31	11.2	11.9	12.6	13.3	14.0	14.7	15.4	16.1	16.9	17.6	18.3	19.0	19.7	20.4	21.1	21.8
32	11.4	12.2	12.9	13.6	14.3	15.1	15.8	16.5	17.2	18.0	18.7	19.4	20.1	20.9	21.6	22.3
33	11.7	12.4	13.1	13.9	14.6	15.4	16.1	16.9	17.6	18.4	19.1	19.8	20.6	21.3	22.1	22.8
34	11.9	12.6	13.4	14.2	14.9	15.7	16.5	17.2	18.0	18.7	19.5	20.3	21.0	21.8	22.5	23.3
35	12.1	12.9	13.7	14.4	15.2	16.0	16.8	17.6	18.3	19.1	19.9	20.7	21.5	22.2	23.0	23.8
36	12.3	13.1	13.9	14.7	15.5	16.3	17.1	17.9	18.7	19.5	20.3	21.1	21.9	22.7	23.5	24.3
37	12.5	13.4	14.2	15.0	15.8	16.6	17.4	18.2	19.0	19.9	20.7	21.5	22.3	23.1	23.9	24.7
38	12.8	13.6	14.4	15.2	16.1	16.9	17.7	18.6	19.4	20.2	21.0	21.9	22.7	23.5	24.3	25.2
39	13.0	13.8	14.7	15.5	16.3	17.2	18.0	18.9	19.7	20.6	21.4	22.3	23.1	23.9	24.8	25.6
40	13.2	14.0	14.9	15.7	16.6	17.5	18.3	19.2	20.1	20.9	21.8	22.6	23.5	24.3	25.2	26.1
41	13.4	14.2	15.1	16.0	16.9	17.7	18.6	19.5	20.4	21.2	22.1	23.0	23.9	24.7	25.6	26.5
42	13.6	14.5	15.3	16.2	17.1	18.0	18.9	19.8	20.7	21.6	22.5	23.4	24.2	25.1	26.0	26.9
43	13.8	14.7	15.6	16.5	17.4	18.3	19.2	20.1	21.0	21.9	22.8	23.7	24.6	25.5	26.4	27.3
44	13.9	14.9	15.8	16.7	17.6	18.5	19.5	20.4	21.3	22.2	23.1	24.1	25.0	25.9	26.8	27.7
45	14.1	15.1	16.0	16.9	17.9	18.8	19.7	20.7	21.6	22.5	23.5	24.4	25.3	26.3	27.2	28.1
46	14.3	15.3	16.2	17.1	18.1	19.0	20.0	20.9	21.9	22.8	23.8	24.7	25.7	26.6	27.6	28.5
47	14.5	15.4	16.4	17.4	18.3	19.3	20.3	21.2	22.2	23.1	24.1	25.1	26.0	27.0	27.9	28.9
48	14.7	15.6	16.6	17.6	18.6	19.5	20.5	21.5	22.5	23.4	24.4	25.4	26.3	27.3	28.3	29.3
49	14.8	15.8	16.8	17.8	18.8	19.8	20.8	21.7	22.7	23.7	24.7	25.7	26.7	27.7	28.7	29.6
50	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0	29.0	30.0
51	15.2	16.2	17.2	18.2	19.2	20.2	21.2	22.3	23.3	24.3	25.3	26.3	27.3	28.3	29.3	30.4
52	15.3	16.4	17.4	18.4	19.4	20.5	21.5	22.5	23.5	24.6	25.6	26.6	27.6	28.7	29.7	30.7
53	15.5	16.5	17.6	18.6	19.6	20.7	21.7	22.7	23.8	24.8	25.9	26.9	27.9	29.0	30.0	31.0
54	15.6	16.7	17.7	18.8	19.8	20.9	21.9	23.0	24.0	25.1	26.1	27.2	28.2	29.3	30.3	31.4
55	15.8	16.9	17.9	19.0	20.0	21.1	22.2	23.2	24.3	25.3	26.4	27.5	28.5	29.6	30.7	31.7
56	16.0	17.0	18.1	19.2	20.2	21.3	22.4	23.5	24.5	25.6	26.7	27.7	28.8	29.9	31.0	32.0
57	16.1	17.2	18.3	19.4	20.4	21.5	22.6	23.7	24.8	25.8	26.9	28.0	29.1	30.2	31.3	32.4
58	16.3	17.3	18.4	19.5	20.6	21.7	22.8	23.9	25.0	26.1	27.2	28.3	29.4	30.5	31.6	32.7
59	16.4	17.5	18.6	19.7	20.8	21.9	23.0	24.1	25.2	26.3	27.4	28.5	29.7	30.8	31.9	33.0
60	16.5	17.7	18.8	19.9	21.0	22.1	23.2	24.3	25.5	26.6	27.7	28.8	29.9	31.0	32.2	33.3
61	16.7	17.8	18.9	20.1	21.2	22.3	23.4	24.6	25.7	26.8	27.9	29.1	30.2	31.3	32.5	33.6
62	16.8	18.0	19.1	20.2	21.4	22.5	23.6	24.8	25.9	27.0	28.2	29.3	30.5	31.6	32.7	33.9
63	17.0	18.1	19.2	20.4	21.5	22.7	23.8	25.0	26.1	27.3	28.4	29.6	30.7	31.9	33.0	34.2
64	17.1	18.2	19.4	20.6	21.7	22.9	24.0	25.2	26.3	27.5	28.6	29.8	31.0	32.1	33.3	34.5
65	17.2	18.4	19.5	20.7	21.9	23.0	24.2	25.4	26.5	27.7	28.9	30.0	31.2	32.4	33.6	34.7
66	17.3	18.5	19.7	20.9	22.0	23.2	24.4	25.6	26.7	27.9	29.1	30.3	31.5	32.6	33.8	35.0
67	17.5	18.7	19.8	21.0	22.2	23.4	24.6	25.8	26.9	28.1	29.3	30.5	31.7	32.9	34.1	35.3
68	17.6	18.8	20.0	21.2	22.4	23.6	24.8	26.0	27.1	28.3	29.5	30.7	31.9	33.1	34.3	35.6
69	17.7	18.9	20.1	21.3	22.5	23.7	24.9	26.1	27.3	28.5	29.8	31.0	32.2	33.4	34.6	35.8
70	17.8	19.1	20.3	21.5	22.7	23.9	25.1	26.3	27.5	28.8	30.0	31.2	32.4	33.6	34.8	36.1
71	18.0	19.2	20.4	21.6	22.8	24.1	25.3	26.5	27.7	29.0	30.2	31.4	32.6	33.9	35.1	36.3
72	18.1	19.3	20.5	21.8	23.0	24.2	25.5	26.7	27.9	29.1	30.4	31.6	32.9	34.1	35.3	36.6
73	18.2	19.4	20.7	21.9	23.2	24.4	25.6	26.9	28.1	29.3	30.6	31.8	33.1	34.3	35.6	36.8
74	18.3	19.6	20.8	22.1	23.3	24.5	25.8	27.0	28.3	29.5	30.8	32.0	33.3	34.5	35.8	37.1
75	18.4	19.7	20.9	22.2	23.4	24.7	26.0	27.2	28.5	29.7	31.0	32.2	33.5	34.8	36.0	37.3
Years to Breast Ht.	11	11	10	10	10	10	10	10	9	9	9	9	9	9	8	8

* A glossary follows Table A-2.

SITE INDEX TABLE FOR COASTAL DOUGLAS-FIR

TABLE A-1. Top height by breast-height (bh) age and site (Bruce 1981) — *Continued*

AGE @bh (years)	BREAST-HEIGHT SITE INDEX (m)															AGE @bh (years)
	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	
	TOP HEIGHT (m)															
1	1.9	1.9	1.9	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.1	2.1	2.1	2.1	2.1	1
2	2.5	2.6	2.6	2.6	2.6	2.7	2.7	2.7	2.8	2.8	2.8	2.9	2.9	2.9	3.0	2
3	3.2	3.2	3.3	3.3	3.4	3.4	3.5	3.5	3.6	3.6	3.7	3.7	3.8	3.9	3.9	3
4	3.9	4.0	4.0	4.1	4.2	4.2	4.3	4.4	4.5	4.5	4.6	4.7	4.8	4.8	4.9	4
5	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.8	5.9	6.0	5
6	5.4	5.5	5.6	5.7	5.9	6.0	6.1	6.2	6.3	6.5	6.6	6.7	6.8	7.0	7.1	6
7	6.2	6.3	6.4	6.6	6.7	6.9	7.0	7.2	7.3	7.4	7.6	7.7	7.9	8.0	8.2	7
8	6.9	7.1	7.3	7.4	7.6	7.8	7.9	8.1	8.3	8.4	8.6	8.8	9.0	9.2	9.3	8
9	7.7	7.9	8.1	8.3	8.5	8.7	8.9	9.1	9.3	9.5	9.7	9.9	10.1	10.3	10.5	9
10	8.5	8.7	8.9	9.1	9.4	9.6	9.8	10.0	10.2	10.5	10.7	10.9	11.1	11.4	11.6	10
11	9.3	9.5	9.8	10.0	10.2	10.5	10.7	11.0	11.2	11.5	11.7	12.0	12.2	12.5	12.7	11
12	10.0	10.3	10.6	10.8	11.1	11.4	11.7	11.9	12.2	12.5	12.7	13.0	13.3	13.6	13.9	12
13	10.8	11.1	11.4	11.7	12.0	12.3	12.6	12.9	13.2	13.5	13.8	14.1	14.4	14.7	15.0	13
14	11.6	11.9	12.2	12.5	12.8	13.2	13.5	13.8	14.1	14.4	14.8	15.1	15.4	15.7	16.1	14
15	12.3	12.6	13.0	13.3	13.7	14.0	14.4	14.7	15.1	15.4	15.8	16.1	16.4	16.8	17.2	15
16	13.0	13.4	13.8	14.1	14.5	14.9	15.2	15.6	16.0	16.4	16.7	17.1	17.5	17.8	18.2	16
17	13.7	14.1	14.5	14.9	15.3	15.7	16.1	16.5	16.9	17.3	17.7	18.1	18.5	18.9	19.3	17
18	14.5	14.9	15.3	15.7	16.1	16.5	17.0	17.4	17.8	18.2	18.6	19.0	19.5	19.9	20.3	18
19	15.1	15.6	16.0	16.5	16.9	17.4	17.8	18.2	18.7	19.1	19.6	20.0	20.4	20.9	21.3	19
20	15.8	16.3	16.8	17.2	17.7	18.2	18.6	19.1	19.5	20.0	20.5	20.9	21.4	21.9	22.3	20
21	16.5	17.0	17.5	18.0	18.5	18.9	19.4	19.9	20.4	20.9	21.4	21.8	22.3	22.8	23.3	21
22	17.2	17.7	18.2	18.7	19.2	19.7	20.2	20.7	21.2	21.7	22.2	22.7	23.2	23.8	24.3	22
23	17.8	18.3	18.9	19.4	19.9	20.5	21.0	21.5	22.0	22.6	23.1	23.6	24.1	24.7	25.2	23
24	18.4	19.0	19.5	20.1	20.6	21.2	21.7	22.3	22.8	23.4	23.9	24.5	25.0	25.6	26.1	24
25	19.0	19.6	20.2	20.8	21.3	21.9	22.5	23.1	23.6	24.2	24.8	25.3	25.9	26.5	27.0	25
26	19.6	20.2	20.8	21.4	22.0	22.6	23.2	23.8	24.4	25.0	25.6	26.2	26.7	27.3	27.9	26
27	20.2	20.9	21.5	22.1	22.7	23.3	23.9	24.5	25.1	25.8	26.4	27.0	27.6	28.2	28.8	27
28	20.8	21.5	22.1	22.7	23.4	24.0	24.6	25.3	25.9	26.5	27.1	27.8	28.4	29.0	29.7	28
29	21.4	22.0	22.7	23.4	24.0	24.7	25.3	26.0	26.6	27.3	27.9	28.6	29.2	29.9	30.5	29
30	21.9	22.6	23.3	24.0	24.6	25.3	26.0	26.7	27.3	28.0	28.7	29.3	30.0	30.7	31.3	30
31	22.5	23.2	23.9	24.6	25.3	26.0	26.6	27.3	28.0	28.7	29.4	30.1	30.8	31.4	32.1	31
32	23.0	23.7	24.4	25.2	25.9	26.6	27.3	28.0	28.7	29.4	30.1	30.8	31.5	32.2	32.9	32
33	23.5	24.3	25.0	25.7	26.5	27.2	27.9	28.6	29.4	30.1	30.8	31.5	32.3	33.0	33.7	33
34	24.0	24.8	25.6	26.3	27.0	27.8	28.5	29.3	30.0	30.8	31.5	32.2	33.0	33.7	34.5	34
35	24.5	25.3	26.1	26.9	27.6	28.4	29.1	29.9	30.7	31.4	32.2	32.9	33.7	34.5	35.2	35
36	25.0	25.8	26.6	27.4	28.2	29.0	29.7	30.5	31.3	32.1	32.9	33.6	34.4	35.2	36.0	36
37	25.5	26.3	27.1	27.9	28.7	29.5	30.3	31.1	31.9	32.7	33.5	34.3	35.1	35.9	36.7	37
38	26.0	26.8	27.6	28.5	29.3	30.1	30.9	31.7	32.5	33.3	34.1	35.0	35.8	36.6	37.4	38
39	26.5	27.3	28.1	29.0	29.8	30.6	31.5	32.3	33.1	33.9	34.8	35.6	36.4	37.3	38.1	39
40	26.9	27.8	28.6	29.5	30.3	31.2	32.0	32.9	33.7	34.6	35.4	36.2	37.1	37.9	38.8	40
41	27.4	28.2	29.1	30.0	30.8	31.7	32.6	33.4	34.3	35.1	36.0	36.9	37.7	38.6	39.4	41
42	27.8	28.7	29.6	30.4	31.3	32.2	33.1	34.0	34.8	35.7	36.6	37.5	38.4	39.2	40.1	42
43	28.2	29.1	30.0	30.9	31.8	32.7	33.6	34.5	35.4	36.3	37.2	38.1	39.0	39.9	40.8	43
44	28.6	29.6	30.5	31.4	32.3	33.2	34.1	35.0	35.9	36.8	37.8	38.7	39.6	40.5	41.4	44
45	29.1	30.0	30.9	31.8	32.8	33.7	34.6	35.5	36.5	37.4	38.3	39.2	40.2	41.1	42.0	45
46	29.5	30.4	31.3	32.3	33.2	34.2	35.1	36.1	37.0	37.9	38.9	39.8	40.8	41.7	42.6	46
47	29.9	30.8	31.8	32.7	33.7	34.6	35.6	36.6	37.5	38.5	39.4	40.4	41.3	42.3	43.2	47
48	30.2	31.2	32.2	33.2	34.1	35.1	36.1	37.0	38.0	39.0	40.0	40.9	41.9	42.9	43.8	48
49	30.6	31.6	32.6	33.6	34.6	35.6	36.5	37.5	38.5	39.5	40.5	41.5	42.5	43.4	44.4	49
50	31.0	32.0	33.0	34.0	35.0	36.0	37.0	38.0	39.0	40.0	41.0	42.0	43.0	44.0	45.0	50
51	31.4	32.4	33.4	34.4	35.4	36.4	37.5	38.5	39.5	40.5	41.5	42.5	43.5	44.6	45.6	51
52	31.7	32.8	33.8	34.8	35.8	36.9	37.9	38.9	40.0	41.0	42.0	43.0	44.1	45.1	46.1	52
53	32.1	33.1	34.2	35.2	36.2	37.3	38.3	39.4	40.4	41.5	42.5	43.5	44.6	45.6	46.7	53
54	32.4	33.5	34.5	35.6	36.6	37.7	38.8	39.8	40.9	41.9	43.0	44.0	45.1	46.2	47.2	54
55	32.8	33.8	34.9	36.0	37.0	38.1	39.2	40.3	41.3	42.4	43.5	44.5	45.6	46.7	47.7	55
56	33.1	34.2	35.3	36.4	37.4	38.5	39.6	40.7	41.8	42.8	43.9	45.0	46.1	47.2	48.3	56
57	33.5	34.5	35.6	36.7	37.8	38.9	40.0	41.1	42.2	43.3	44.4	45.5	46.6	47.7	48.8	57
58	33.8	34.9	36.0	37.1	38.2	39.3	40.4	41.5	42.6	43.7	44.8	46.0	47.1	48.2	49.3	58
59	34.1	35.2	36.3	37.4	38.6	39.7	40.8	41.9	43.0	44.2	45.3	46.4	47.5	48.7	49.8	59
60	34.4	35.5	36.7	37.8	38.9	40.1	41.2	42.3	43.5	44.6	45.7	46.9	48.0	49.2	50.3	60
61	34.7	35.9	37.0	38.1	39.3	40.4	41.6	42.7	43.9	45.0	46.2	47.3	48.5	49.6	50.8	61
62	35.0	36.2	37.3	38.5	39.6	40.8	41.9	43.1	44.3	45.4	46.6	47.8	48.9	50.1	51.3	62
63	35.3	36.5	37.7	38.8	40.0	41.1	42.3	43.5	44.7	45.8	47.0	48.2	49.4	50.5	51.7	63
64	35.6	36.8	38.0	39.1	40.3	41.5	42.7	43.9	45.0	46.2	47.4	48.6	49.8	51.0	52.2	64
65	35.9	37.1	38.3	39.5	40.7	41.8	43.0	44.2	45.4	46.6	47.8	49.0	50.2	51.4	52.6	65
66	36.2	37.4	38.6	39.8	41.0	42.2	43.4	44.6	45.8	47.0	48.2	49.5	50.7	51.9	53.1	66
67	36.5	37.7	38.9	40.1	41.3	42.5	43.7	45.0	46.2	47.4	48.6	49.9	51.1	52.3	53.5	67
68	36.8	38.0	39.2	40.4	41.6	42.9	44.1	45.3	46.5	47.8	49.0	50.3	51.5	52.7	54.0	68
69	37.0	38.3	39.5	40.7	41.9	43.2	44.4	45.7	46.9	48.2	49.4	50.7	51.9	53.2	54.4	69
70	37.3	38.5	39.8	41.0	42.3	43.5	44.8	46.0	47.3	48.5	49.8	51.0	52.3	53.6	54.8	70
71	37.6	38.8	40.1	41.3	42.6	43.8	45.1	46.3	47.6	48.9	50.2	51.4	52.7	54.0	55.3	71
72	37.8	39.1	40.3	41.6	42.9	44.1	45.4	46.7	48.0	49.2	50.5	51.8	53.1	54.4	55.7	72
73	38.1	39.4	40.6	41.9	43.2	44.4	45.7	47.0	48.3	49.6	50.9	52.2	53.5	54.8	56.1	73
74	38.3	39.6	40.9	42.2	43.5	44.7	46.0	47.3	48.6	49.9	51.2	52.6	53.9	55.2	56.5	74
75	38.6	39.9	41.2	42.5	43.7	45.0	46.3	47.7	49.0	50.3	51.6	52.9	54.2	55.6	56.9	75
Years to Breast Ht.	8	8	8	8	8	7	7	7	7	7	7	6	6	6	6	Years. to Breast Ht.

SITE INDEX TABLE FOR COASTAL DOUGLAS-FIR

TABLE A-1. Top height by breast-height (bh) age and site (Bruce 1981) — *Continued*

AGE @bh (years)	BREAST-HEIGHT SITE INDEX (m)															
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
	TOP HEIGHT (m)															
76	18.5	19.8	21.1	22.3	23.6	24.9	26.1	27.4	28.6	29.9	31.2	32.4	33.7	35.0	36.3	37.6
77	18.7	19.9	21.2	22.5	23.7	25.0	26.3	27.5	28.8	30.1	31.4	32.6	33.9	35.2	36.5	37.8
78	18.8	20.0	21.3	22.6	23.9	25.2	26.4	27.7	29.0	30.3	31.6	32.8	34.1	35.4	36.7	38.0
79	18.9	20.2	21.4	22.7	24.0	25.3	26.6	27.9	29.2	30.4	31.7	33.0	34.3	35.6	36.9	38.2
80	19.0	20.3	21.6	22.9	24.1	25.4	26.7	28.0	29.3	30.6	31.9	33.2	34.5	35.8	37.1	38.5
81	19.1	20.4	21.7	23.0	24.3	25.6	26.9	28.2	29.5	30.8	32.1	33.4	34.7	36.0	37.4	38.7
82	19.2	20.5	21.8	23.1	24.4	25.7	27.0	28.3	29.6	31.0	32.3	33.6	34.9	36.2	37.6	38.9
83	19.3	20.6	21.9	23.2	24.5	25.9	27.2	28.5	29.8	31.1	32.5	33.8	35.1	36.4	37.8	39.1
84	19.4	20.7	22.0	23.4	24.7	26.0	27.3	28.6	30.0	31.3	32.6	34.0	35.3	36.6	38.0	39.3
85	19.5	20.8	22.1	23.5	24.8	26.1	27.5	28.8	30.1	31.5	32.8	34.1	35.5	36.8	38.2	39.5
86	19.6	20.9	22.3	23.6	24.9	26.3	27.6	28.9	30.3	31.6	33.0	34.3	35.7	37.0	38.4	39.7
87	19.7	21.0	22.4	23.7	25.1	26.4	27.7	29.1	30.4	31.8	33.1	34.5	35.8	37.2	38.6	40.0
88	19.8	21.1	22.5	23.8	25.2	26.5	27.9	29.2	30.6	31.9	33.3	34.7	36.0	37.4	38.8	40.2
89	19.9	21.2	22.6	23.9	25.3	26.7	28.0	29.4	30.7	32.1	33.5	34.8	36.2	37.6	39.0	40.3
90	20.0	21.3	22.7	24.1	25.4	26.8	28.1	29.5	30.9	32.2	33.6	35.0	36.4	37.8	39.1	40.5
91	20.0	21.4	22.8	24.2	25.5	26.9	28.3	29.6	31.0	32.4	33.8	35.2	36.5	37.9	39.3	40.7
92	20.1	21.5	22.9	24.3	25.6	27.0	28.4	29.8	31.2	32.5	33.9	35.3	36.7	38.1	39.5	40.9
93	20.2	21.6	23.0	24.4	25.8	27.1	28.5	29.9	31.3	32.7	34.1	35.5	36.9	38.3	39.7	41.1
94	20.3	21.7	23.1	24.5	25.9	27.3	28.7	30.0	31.4	32.8	34.2	35.6	37.0	38.5	39.9	41.3
95	20.4	21.8	23.2	24.6	26.0	27.4	28.8	30.2	31.6	33.0	34.4	35.8	37.2	38.6	40.0	41.5
96	20.5	21.9	23.3	24.7	26.1	27.5	28.9	30.3	31.7	33.1	34.5	35.9	37.4	38.8	40.2	41.7
97	20.6	22.0	23.4	24.8	26.2	27.6	29.0	30.4	31.8	33.3	34.7	36.1	37.5	39.0	40.4	41.8
98	20.7	22.1	23.5	24.9	26.3	27.7	29.1	30.6	32.0	33.4	34.8	36.2	37.7	39.1	40.6	42.0
99	20.7	22.2	23.6	25.0	26.4	27.8	29.3	30.7	32.1	33.5	35.0	36.4	37.8	39.3	40.7	42.2
100	20.8	22.3	23.7	25.1	26.5	27.9	29.4	30.8	32.2	33.7	35.1	36.5	38.0	39.4	40.9	42.4
101	20.9	22.3	23.8	25.2	26.6	28.1	29.5	30.9	32.4	33.8	35.2	36.7	38.1	39.6	41.1	42.5
102	21.0	22.4	23.9	25.3	26.7	28.2	29.6	31.0	32.5	33.9	35.4	36.8	38.3	39.7	41.2	42.7
103	21.1	22.5	24.0	25.4	26.8	28.3	29.7	31.2	32.6	34.1	35.5	37.0	38.4	39.9	41.4	42.9
104	21.1	22.6	24.0	25.5	26.9	28.4	29.8	31.3	32.7	34.2	35.6	37.1	38.6	40.1	41.5	43.0
105	21.2	22.7	24.1	25.6	27.0	28.5	29.9	31.4	32.8	34.3	35.8	37.2	38.7	40.2	41.7	43.2
106	21.3	22.8	24.2	25.7	27.1	28.6	30.0	31.5	33.0	34.4	35.9	37.4	38.9	40.4	41.8	43.4
107	21.4	22.8	24.3	25.8	27.2	28.7	30.1	31.6	33.1	34.6	36.0	37.5	39.0	40.5	42.0	43.5
108	21.4	22.9	24.4	25.9	27.3	28.8	30.3	31.7	33.2	34.7	36.2	37.6	39.1	40.6	42.2	43.7
109	21.5	23.0	24.5	25.9	27.4	28.9	30.4	31.8	33.3	34.8	36.3	37.8	39.3	40.8	42.3	43.8
110	21.6	23.1	24.6	26.0	27.5	29.0	30.5	31.9	33.4	34.9	36.4	37.9	39.4	40.9	42.4	44.0
111	21.7	23.2	24.6	26.1	27.6	29.1	30.6	32.0	33.5	35.0	36.5	38.0	39.5	41.1	42.6	44.1
112	21.7	23.2	24.7	26.2	27.7	29.2	30.7	32.2	33.6	35.1	36.7	38.2	39.7	41.2	42.7	44.3
113	21.8	23.3	24.8	26.3	27.8	29.3	30.8	32.3	33.8	35.3	36.8	38.3	39.8	41.3	42.9	44.4
114	21.9	23.4	24.9	26.4	27.9	29.4	30.9	32.4	33.9	35.4	36.9	38.4	39.9	41.5	43.0	44.6
115	21.9	23.5	25.0	26.5	28.0	29.5	31.0	32.5	34.0	35.5	37.0	38.5	40.1	41.6	43.2	44.7
116	22.0	23.5	25.0	26.5	28.0	29.6	31.1	32.6	34.1	35.6	37.1	38.7	40.2	41.7	43.3	44.9
117	22.1	23.6	25.1	26.6	28.1	29.6	31.2	32.7	34.2	35.7	37.2	38.8	40.3	41.9	43.4	45.0
118	22.1	23.7	25.2	26.7	28.2	29.7	31.2	32.8	34.3	35.8	37.4	38.9	40.4	42.0	43.6	45.1
119	22.2	23.7	25.3	26.8	28.3	29.8	31.3	32.9	34.4	35.9	37.5	39.0	40.6	42.1	43.7	45.3
120	22.3	23.8	25.3	26.9	28.4	29.9	31.4	33.0	34.5	36.0	37.6	39.1	40.7	42.3	43.8	45.4
121	22.3	23.9	25.4	26.9	28.5	30.0	31.5	33.1	34.6	36.1	37.7	39.2	40.8	42.4	44.0	45.6
122	22.4	23.9	25.5	27.0	28.6	30.1	31.6	33.2	34.7	36.2	37.8	39.4	40.9	42.5	44.1	45.7
123	22.5	24.0	25.6	27.1	28.6	30.2	31.7	33.2	34.8	36.3	37.9	39.5	41.0	42.6	44.2	45.8
124	22.5	24.1	25.6	27.2	28.7	30.3	31.8	33.3	34.9	36.4	38.0	39.6	41.2	42.7	44.3	46.0
125	22.6	24.2	25.7	27.2	28.8	30.3	31.9	33.4	35.0	36.5	38.1	39.7	41.3	42.9	44.5	46.1
126	22.7	24.2	25.8	27.3	28.9	30.4	32.0	33.5	35.1	36.6	38.2	39.8	41.4	43.0	44.6	46.2
127	22.7	24.3	25.8	27.4	28.9	30.5	32.1	33.6	35.2	36.7	38.3	39.9	41.5	43.1	44.7	46.3
128	22.8	24.3	25.9	27.5	29.0	30.6	32.1	33.7	35.3	36.8	38.4	40.0	41.6	43.2	44.8	46.5
129	22.8	24.4	26.0	27.5	29.1	30.7	32.2	33.8	35.4	36.9	38.5	40.1	41.7	43.3	45.0	46.6
130	22.9	24.5	26.0	27.6	29.2	30.7	32.3	33.9	35.5	37.0	38.6	40.2	41.8	43.4	45.1	46.7
131	23.0	24.5	26.1	27.7	29.3	30.8	32.4	34.0	35.5	37.1	38.7	40.3	41.9	43.6	45.2	46.8
132	23.0	24.6	26.2	27.8	29.3	30.9	32.5	34.1	35.6	37.2	38.8	40.4	42.0	43.7	45.3	47.0
133	23.1	24.7	26.2	27.8	29.4	31.0	32.6	34.1	35.7	37.3	38.9	40.5	42.1	43.8	45.4	47.1
134	23.1	24.7	26.3	27.9	29.5	31.1	32.6	34.2	35.8	37.4	39.0	40.6	42.3	43.9	45.5	47.2
135	23.2	24.8	26.4	28.0	29.5	31.1	32.7	34.3	35.9	37.5	39.1	40.7	42.4	44.0	45.6	47.3
136	23.2	24.8	26.4	28.0	29.6	31.2	32.8	34.4	36.0	37.6	39.2	40.8	42.5	44.1	45.8	47.4
137	23.3	24.9	26.5	28.1	29.7	31.3	32.9	34.5	36.1	37.7	39.3	40.9	42.6	44.2	45.9	47.5
138	23.4	25.0	26.6	28.2	29.8	31.3	32.9	34.5	36.2	37.8	39.4	41.0	42.7	44.3	46.0	47.7
139	23.4	25.0	26.6	28.2	29.8	31.4	33.0	34.6	36.2	37.9	39.5	41.1	42.8	44.4	46.1	47.8
140	23.5	25.1	26.7	28.3	29.9	31.5	33.1	34.7	36.3	37.9	39.6	41.2	42.9	44.5	46.2	47.9
141	23.5	25.1	26.7	28.3	30.0	31.6	33.2	34.8	36.4	38.0	39.7	41.3	43.0	44.6	46.3	48.0
142	23.6	25.2	26.8	28.4	30.0	31.6	33.2	34.9	36.5	38.1	39.8	41.4	43.1	44.7	46.4	48.1
143	23.6	25.2	26.9	28.5	30.1	31.7	33.3	34.9	36.6	38.2	39.8	41.5	43.2	44.8	46.5	48.2
144	23.7	25.3	26.9	28.5	30.2	31.8	33.4	35.0	36.6	38.3	39.9	41.6	43.2	44.9	46.6	48.3
145	23.7	25.4	27.0	28.6	30.2	31.8	33.5	35.1	36.7	38.4	40.0	41.7	43.3	45.0	46.7	48.4
146	23.8	25.4	27.0	28.7	30.3	31.9	33.5	35.2	36.8	38.4	40.1	41.8	43.4	45.1	46.8	48.5
147	23.8	25.5	27.1	28.7	30.3	32.0	33.6	35.2	36.9	38.5	40.2	41.8	43.5	45.2	46.9	48.6
148	23.9	25.5	27.1	28.8	30.4	32.0	33.7	35.3	37.0	38.6	40.3	41.9	43.6	45.3	47.0	48.7
149	23.9	25.6	27.2	28.8	30.5	32.1	33.7	35.4	37.0	38.7	40.4	42.0	43.7	45.4	47.1	48.8
150	24.0	25.6	27.3	28.9	30.5	32.2	33.8	35.5	37.1	38.8	40.4	42.1	43.8	45.5	47.2	49.0
Years to Breast Ht.	11	11	10	10	10	10	10	10	9	9	9	9	9	9	8	8

SITE INDEX TABLE FOR COASTAL DOUGLAS-FIR

TABLE A-1. Top height by breast-height (bh) age and site (Bruce 1981) — *Concluded*

AGE @bh (years)	BREAST-HEIGHT SITE INDEX (m)															AGE @bh (years)
	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	
	TOP HEIGHT (m)															
76	38.8	40.1	41.4	42.7	44.0	45.3	46.7	48.0	49.3	50.6	52.0	53.3	54.6	56.0	57.3	76
77	39.1	40.4	41.7	43.0	44.3	45.6	47.0	48.3	49.6	51.0	52.3	53.6	55.0	56.3	57.7	77
78	39.3	40.6	41.9	43.3	44.6	45.9	47.3	48.6	49.9	51.3	52.6	54.0	55.3	56.7	58.1	78
79	39.6	40.9	42.2	43.5	44.9	46.2	47.5	48.9	50.3	51.6	53.0	54.3	55.7	57.1	58.4	79
80	39.8	41.1	42.5	43.8	45.1	46.5	47.8	49.2	50.6	51.9	53.3	54.7	56.1	57.4	58.8	80
81	40.0	41.4	42.7	44.0	45.4	46.8	48.1	49.5	50.9	52.2	53.6	55.0	56.4	57.8	59.2	81
82	40.2	41.6	42.9	44.3	45.7	47.0	48.4	49.8	51.2	52.6	54.0	55.3	56.8	58.2	59.6	82
83	40.5	41.8	43.2	44.5	45.9	47.3	48.7	50.1	51.5	52.9	54.3	55.7	57.1	58.5	59.9	83
84	40.7	42.1	43.4	44.8	46.2	47.6	49.0	50.4	51.8	53.2	54.6	56.0	57.4	58.8	60.3	84
85	40.9	42.3	43.7	45.0	46.4	47.8	49.2	50.6	52.0	53.5	54.9	56.3	57.8	59.2	60.6	85
86	41.1	42.5	43.9	45.3	46.7	48.1	49.5	50.9	52.3	53.8	55.2	56.6	58.1	59.5	61.0	86
87	41.3	42.7	44.1	45.5	46.9	48.3	49.8	51.2	52.6	54.1	55.5	57.0	58.4	59.9	61.3	87
88	41.5	42.9	44.3	45.7	47.2	48.6	50.0	51.5	52.9	54.3	55.8	57.3	58.7	60.2	61.7	88
89	41.7	43.1	44.6	46.0	47.4	48.8	50.3	51.7	53.2	54.6	56.1	57.6	59.0	60.5	62.0	89
90	41.9	43.4	44.8	46.2	47.6	49.1	50.5	52.0	53.4	54.9	56.4	57.9	59.4	60.8	62.3	90
91	42.1	43.6	45.0	46.4	47.9	49.3	50.8	52.2	53.7	55.2	56.7	58.2	59.7	61.2	62.7	91
92	42.3	43.8	45.2	46.7	48.1	49.6	51.0	52.5	54.0	55.5	57.0	58.5	60.0	61.5	63.0	92
93	42.5	44.0	45.4	46.9	48.3	49.8	51.3	52.8	54.2	55.7	57.2	58.8	60.3	61.8	63.3	93
94	42.7	44.2	45.6	47.1	48.6	50.0	51.5	53.0	54.5	56.0	57.5	59.0	60.6	62.1	63.6	94
95	42.9	44.4	45.8	47.3	48.8	50.3	51.7	53.2	54.8	56.3	57.8	59.3	60.9	62.4	63.9	95
96	43.1	44.6	46.0	47.5	49.0	50.5	52.0	53.5	55.0	56.5	58.1	59.6	61.1	62.7	64.2	96
97	43.3	44.8	46.2	47.7	49.2	50.7	52.2	53.7	55.3	56.8	58.3	59.9	61.4	63.0	64.5	97
98	43.5	45.0	46.4	47.9	49.4	50.9	52.4	54.0	55.5	57.1	58.6	60.2	61.7	63.3	64.9	98
99	43.7	45.1	46.6	48.1	49.6	51.2	52.7	54.2	55.8	57.3	58.9	60.4	62.0	63.6	65.2	99
100	43.8	45.3	46.8	48.3	49.8	51.4	52.9	54.4	56.0	57.6	59.1	60.7	62.3	63.9	65.4	100
101	44.0	45.5	47.0	48.5	50.1	51.6	53.1	54.7	56.2	57.8	59.4	61.0	62.6	64.1	65.7	101
102	44.2	45.7	47.2	48.7	50.3	51.8	53.3	54.9	56.5	58.0	59.6	61.2	62.8	64.4	66.0	102
103	44.4	45.9	47.4	48.9	50.5	52.0	53.6	55.1	56.7	58.3	59.9	61.5	63.1	64.7	66.3	103
104	44.5	46.1	47.6	49.1	50.7	52.2	53.8	55.3	56.9	58.5	60.1	61.7	63.4	65.0	66.6	104
105	44.7	46.2	47.8	49.3	50.9	52.4	54.0	55.6	57.2	58.8	60.4	62.0	63.6	65.3	66.9	105
106	44.9	46.4	47.9	49.5	51.0	52.6	54.2	55.8	57.4	59.0	60.6	62.2	63.9	65.5	67.2	106
107	45.0	46.6	48.1	49.7	51.2	52.8	54.4	56.0	57.6	59.2	60.9	62.5	64.1	65.8	67.4	107
108	45.2	46.7	48.3	49.9	51.4	53.0	54.6	56.2	57.8	59.5	61.1	62.7	64.4	66.1	67.7	108
109	45.4	46.9	48.5	50.0	51.6	53.2	54.8	56.4	58.1	59.7	61.3	63.0	64.6	66.3	68.0	109
110	45.5	47.1	48.6	50.2	51.8	53.4	55.0	56.6	58.3	59.9	61.6	63.2	64.9	66.6	68.3	110
111	45.7	47.2	48.8	50.4	52.0	53.6	55.2	56.8	58.5	60.1	61.8	63.5	65.1	66.8	68.5	111
112	45.8	47.4	49.0	50.6	52.2	53.8	55.4	57.0	58.7	60.4	62.0	63.7	65.4	67.1	68.8	112
113	46.0	47.6	49.1	50.7	52.3	54.0	55.6	57.2	58.9	60.6	62.2	63.9	65.6	67.3	69.0	113
114	46.1	47.7	49.3	50.9	52.5	54.2	55.8	57.4	59.1	60.8	62.5	64.2	65.9	67.6	69.3	114
115	46.3	47.9	49.5	51.1	52.7	54.3	56.0	57.6	59.3	61.0	62.7	64.4	66.1	67.8	69.5	115
116	46.4	48.0	49.6	51.3	52.9	54.5	56.2	57.8	59.5	61.2	62.9	64.6	66.3	68.1	69.8	116
117	46.6	48.2	49.8	51.4	53.1	54.7	56.4	58.0	59.7	61.4	63.1	64.8	66.6	68.3	70.0	117
118	46.7	48.3	50.0	51.6	53.2	54.9	56.5	58.2	59.9	61.6	63.3	65.1	66.8	68.5	70.3	118
119	46.9	48.5	50.1	51.7	53.4	55.1	56.7	58.4	60.1	61.8	63.6	65.3	67.0	68.8	70.5	119
120	47.0	48.6	50.3	51.9	53.6	55.2	56.9	58.6	60.3	62.0	63.8	65.5	67.3	69.0	70.8	120
121	47.2	48.8	50.4	52.1	53.7	55.4	57.1	58.8	60.5	62.2	64.0	65.7	67.5	69.2	71.0	121
122	47.3	48.9	50.6	52.2	53.9	55.6	57.3	59.0	60.7	62.4	64.2	65.9	67.7	69.5	71.3	122
123	47.4	49.1	50.7	52.4	54.0	55.7	57.4	59.2	60.9	62.6	64.4	66.1	67.9	69.7	71.5	123
124	47.6	49.2	50.9	52.5	54.2	55.9	57.6	59.3	61.1	62.8	64.6	66.4	68.1	69.9	71.7	124
125	47.7	49.4	51.0	52.7	54.4	56.1	57.8	59.5	61.3	63.0	64.8	66.6	68.4	70.2	72.0	125
126	47.8	49.5	51.2	52.8	54.5	56.2	58.0	59.7	61.4	63.2	65.0	66.8	68.6	70.4	72.2	126
127	48.0	49.6	51.3	53.0	54.7	56.4	58.1	59.9	61.6	63.4	65.2	67.0	68.8	70.6	72.4	127
128	48.1	49.8	51.4	53.1	54.8	56.6	58.3	60.0	61.8	63.6	65.4	67.2	69.0	70.8	72.6	128
129	48.2	49.9	51.6	53.3	55.0	56.7	58.5	60.2	62.0	63.8	65.6	67.4	69.2	71.0	72.9	129
130	48.4	50.0	51.7	53.4	55.1	56.9	58.6	60.4	62.2	63.9	65.8	67.6	69.4	71.2	73.1	130
131	48.5	50.2	51.9	53.6	55.3	57.0	58.8	60.5	62.3	64.1	65.9	67.8	69.6	71.5	73.3	131
132	48.6	50.3	52.0	53.7	55.4	57.2	58.9	60.7	62.5	64.3	66.1	68.0	69.8	71.7	73.5	132
133	48.7	50.4	52.1	53.9	55.6	57.3	59.1	60.9	62.7	64.5	66.3	68.2	70.0	71.9	73.7	133
134	48.9	50.6	52.3	54.0	55.7	57.5	59.3	61.0	62.8	64.7	66.5	68.3	70.2	72.1	73.9	134
135	49.0	50.7	52.4	54.1	55.9	57.6	59.4	61.2	63.0	64.8	66.7	68.5	70.4	72.3	74.2	135
136	49.1	50.8	52.5	54.3	56.0	57.8	59.6	61.4	63.2	65.0	66.9	68.7	70.6	72.5	74.4	136
137	49.2	50.9	52.7	54.4	56.2	57.9	59.7	61.5	63.3	65.2	67.0	68.9	70.8	72.7	74.6	137
138	49.4	51.1	52.8	54.5	56.3	58.1	59.9	61.7	63.5	65.4	67.2	69.1	71.0	72.9	74.8	138
139	49.5	51.2	52.9	54.7	56.4	58.2	60.0	61.8	63.7	65.5	67.4	69.3	71.2	73.1	75.0	139
140	49.6	51.3	53.0	54.8	56.6	58.4	60.2	62.0	63.8	65.7	67.6	69.5	71.4	73.3	75.2	140
141	49.7	51.4	53.2	54.9	56.7	58.5	60.3	62.1	64.0	65.9	67.7	69.6	71.5	73.5	75.4	141
142	49.8	51.6	53.3	55.1	56.8	58.6	60.5	62.3	64.2	66.0	67.9	69.8	71.7	73.7	75.6	142
143	49.9	51.7	53.4	55.2	57.0	58.8	60.6	62.5	64.3	66.2	68.1	70.0	71.9	73.8	75.8	143
144	50.0	51.8	53.5	55.3	57.1	58.9	60.8	62.6	64.5	66.4	68.3	70.2	72.1	74.0	76.0	144
145	50.2	51.9	53.7	55.4	57.2	59.1	60.9	62.7	64.6	66.5	68.4	70.3	72.3	74.2	76.2	145
146	50.3	52.0	53.8	55.6	57.4	59.2	61.0	62.9	64.8	66.7	68.6	70.5	72.5	74.4	76.4	146
147	50.4	52.1	53.9	55.7	57.5	59.3	61.2	63.0	64.9	66.8	68.7	70.7	72.6	74.6	76.6	147
148	50.5	52.2	54.0	55.8	57.6	59.5	61.3	63.2	65.1	67.0	68.9	70.9	72.8	74.8	76.8	148
149	50.6	52.4	54.1	55.9	57.8	59.6	61.5	63.3	65.2	67.1	69.1	71.0	73.0	75.0	76.9	149
150	50.7	52.5	54.3	56.1	57.9	59.7	61.6	63.5	65.4	67.3	69.2	71.2	73.2	75.1	77.1	150
Years to Breast Ht.	8	8	8	8	8	7	7	7	7	7	7	6	6	6	6	Years. to Breast Ht.

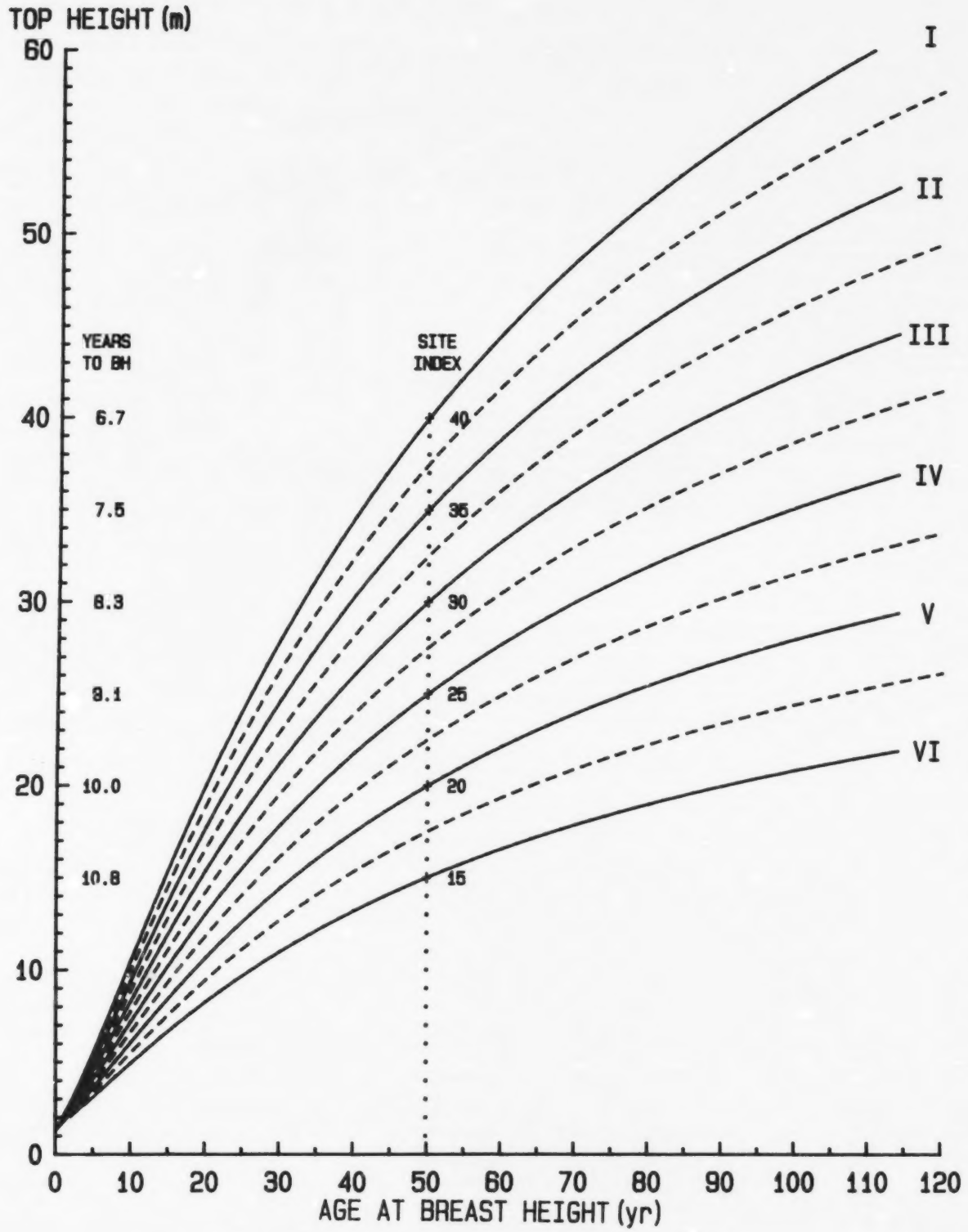

FIGURE A-1. Coastal Douglas-fir site curves and classes.

MANAGED STAND YIELD TABLES — COASTAL DOUGLAS-FIR

TABLE A-2. Breast-height age by reference height and site (Bruce 1981)

Ref. Height (m)	BREAST-HEIGHT SITE INDEX (m) AND CLASS (Bruce 1981)																						
	23	24	25 (IV)	26	27	28	29	30 (III)	31	32	33	34	35 (II)	36	37	38	39	40 (I)	41	42	43	44	45
	BREAST-HEIGHT AGE																						
0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2
6	9	8	8	8	8	7	7	7	7	7	6	6	6	6	6	6	6	6	5	5	5	5	5
(6)	(9)	(8)	(8)	(8)	(8)	(7)	(7)	(7)	(7)	(7)	(6)	(6)	(6)	(6)	(6)	(6)	(6)	(6)	(5)	(5)	(5)	(5)	(5)
9	**14**	**14**	**13**	**13**	**12**	**12**	**11**	**11**	**11**	**10**	**10**	**10**	**10**	**9**	**9**	**9**	**9**	**9**	**8**	**8**	**8**	**8**	**8**
12	**20**	**19**	**18**	**17**	**17**	**16**	**16**	**15**	**15**	**14**	**14**	**13**	**13**	**13**	**12**	**12**	**12**	**12**	**11**	**11**	**11**	**11**	**10**
15	26	25	24	23	22	21	20	19	19	18	18	17	17	16	16	15	15	15	14	14	14	13	13
18	34	32	30	29	28	26	25	24	23	23	22	21	20	20	19	19	18	18	17	17	17	16	16
21	43	40	38	36	34	32	31	30	28	27	26	25	25	24	23	22	22	21	21	20	20	19	19
24	**54**	**50**	**47**	**44**	**41**	**39**	**37**	**35**	**34**	**32**	**31**	**30**	**29**	**28**	**27**	**26**	**25**	**25**	**24**	**23**	**23**	**22**	**22**
27	**67**	**62**	**57**	**53**	**50**	**47**	**45**	**42**	**40**	**38**	**37**	**35**	**34**	**33**	**32**	**31**	**30**	**29**	**28**	**27**	**26**	**26**	**25**
30	**84**	**77**	**70**	**65**	**60**	**56**	**53**	**50**	**47**	**45**	**43**	**41**	**39**	**38**	**36**	**35**	**34**	**33**	**32**	**31**	**30**	**29**	**28**
33	106	95	86	79	73	67	63	59	56	53	50	48	46	44	42	40	39	37	36	35	34	33	32
36	136	120	107	96	88	81	75	70	65	61	58	55	52	50	48	46	44	42	41	40	38	37	36
39	178	153	134	119	107	97	89	82	77	72	67	64	60	57	55	52	50	48	46	45	43	42	40
42	**242**	**200**	**171**	**149**	**132**	**118**	**107**	**98**	**90**	**84**	**78**	**73**	**69**	**65**	**62**	**59**	**57**	**54**	**52**	**50**	**48**	**47**	**45**
45	–	–	**224**	**190**	**164**	**145**	**129**	**117**	**107**	**98**	**91**	**85**	**80**	**75**	**71**	**67**	**64**	**61**	**58**	**56**	**54**	**52**	**50**
48	–	–	–	**249**	**209**	**180**	**158**	**141**	**127**	**116**	**106**	**98**	**92**	**86**	**81**	**76**	**72**	**69**	**65**	**63**	**60**	**58**	**55**
51	–	–	–	–	–	230	197	172	153	137	125	115	106	98	92	86	81	77	73	70	67	64	61
54	–	–	–	–	–	–	250	214	186	165	148	134	123	113	105	98	92	87	82	78	74	71	68
57	–	–	–	–	–	–	–	–	230	200	177	158	143	131	121	112	104	98	92	87	83	79	75
Years to Breast height	9	9	9	9	9	9	8	8	8	8	8	8	8	7	7	7	7	7	7	6	6	6	6

GLOSSARY

Tables	Term	Description	Units
A-1–15	Fd	Douglas-fir species code (followed by table reference code) e.g. Fd 2500-500: Plant 2500 Douglas-fir and thin to 500	
A-1–2	TOP HEIGHT	Average height of the 100 trees/ha of largest diameter	m
	BREAST-HEIGHT AGE	Average age (ring count) of top height trees at a height of 1.37 m	years
	YEARS TO BREAST HT.	Years to grow from seed to breast height (King 1966) (Local information may be substituted in the space provided)	years
	TOTAL AGE	Breast-height age plus years to breast height	years
	SITE INDEX	Top height at breast-height age 50	m
	SITE CLASS	Arbitrary classification of site indices I = 40(37.6 +): Good II = 35(32.6 – 37.5): Good-medium III = 30(27.6 – 32.5): Medium IV = 25(22.6 – 27.5): Medium-poor	
A-2–14	REF. HEIGHT	Reference height used to match corresponding yields	m
A-3–15	VOLUME	Volume of stemwood inside bark (ib)	m^3/ha
	Gross Production	Living trees, accumulated mortality and thinnings	
	Total Standing (0.0 +)	Living trees [= gross total: MOF inventory]	
	(7.5 +)	Trees ≥ 7.5-cm DBH [= gross merchantable: MOF inventory]	
	Merchantable (12.5 +)	Trees ≥ 12.5-cm DBH less a 30-cm stump and 10-cm top (ib)	
	BASAL AREA	Cross-sectional area outside bark (ob) at 1.37 m (0.0 +)	m^2/ha
	MEAN DBHg	Diameter (ob) at breast height of tree of average basal area (0.0 +)	cm
	STEM COUNT	Number of trees (0.0 +)	trees/ha
	CROWN COVER	Ground area covered by tree crowns (0.0 +)	%
	CROP TREES (12.5 +)	250 trees/ha destined to be of largest DBH at maturity (57m)	
	Merch. Vol	Merchantable volume (12.5 +)	m^3/ha
	Mean DBHg	Mean diameter (ob) at breast height (12.5 +)	cm
	Live Crown	Length of crown relative to tree height (12.5 +)	%
	DIAMETER CLASSES	Mid points of 5-cm DBH (ob) classes (trees < 2.5-cm excluded)	cm
	DBH LIMIT	Diameter (ob) of smallest tree included in summary	cm
	SITE INDEX	Top height at breast-height age 50	m
	MAX. MAI	Maximum mean annual increment	m^3/ha
	CULMINATION AGE	Total age at which MAI culminates	years
A-14	TOP HEIGHT	Average height of the 100 trees/ha of largest diameter	m
	MEAN HEIGHT	Average height of all living trees	m

MANAGED STAND YIELD TABLES — COASTAL DOUGLAS-FIR

TABLE A-3. Stand established with 4440 trees/ha — untreated

A-3.1 Cumulative production

REF. HEIGHT (m)	VOLUME (m^3/ha)								BASAL AREA (m^2/ha)	MEAN DBHg (cm)	STEM COUNT (/ha)	CROWN COVER (%)	250 CROP TREES (12.5+)		
	Gross Prod'n	Total Standing		Merchantable									Merch Vol (m^3/ha)	Mean DBHg (cm)	Live Crown (%)
	0.0+	0.0+	7.5+	12.5+	17.5+	22.5+	27.5+	32.5+							
0	0	0	0	0	0	0	0	0	0.0	0.0	4440	0	0	0.0	—
3	2	2	0	0	0	0	0	0	0.4	1.1	4253	48	0	0.0	—
6	17	16	0	0	0	0	0	0	5.3	4.1	4107	89	0	0.0	—
(6)				(UNTREATED)											
9	**50**	**49**	**29**	**0**	**0**	**0**	**0**	**0**	**13.2**	**6.5**	**4006**	**98**	**0**	**0.0**	**—**
12	**109**	**108**	**95**	**25**	**1**	**0**	**0**	**0**	**21.8**	**8.4**	**3944**	**99**	**13**	**14.4**	**65**
15	175	173	161	82	17	0	0	0	29.1	9.9	3781	100	34	17.1	52
18	256	254	243	167	77	5	0	0	35.5	11.4	3464	100	57	19.8	45
21	338	332	324	250	164	45	0	0	40.6	14.0	2651	100	85	22.2	40
24	**426**	**409**	**407**	**335**	**261**	**110**	**15**	**0**	**45.5**	**17.0**	**2002**	**100**	**119**	**24.6**	**37**
27	**524**	**488**	**488**	**426**	**377**	**240**	**88**	**0**	**49.9**	**20.3**	**1542**	**100**	**159**	**27.5**	**34**
30	**634**	**577**	**577**	**515**	**485**	**407**	**209**	**73**	**54.4**	**23.9**	**1216**	**100**	**205**	**30.4**	**31**
33	762	665	665	618	606	549	406	189	58.9	27.2	1016	100	271	33.7	28
36	907	770	770	721	721	705	611	339	62.9	30.6	855	100	346	36.9	26
39	1059	884	884	845	845	845	775	615	66.3	34.0	729	100	432	40.1	24
42	**1230**	**994**	**994**	**976**	**976**	**976**	**938**	**847**	**69.5**	**37.3**	**636**	**100**	**528**	**43.2**	**22**
45	**1406**	**1106**	**1106**	**1092**	**1092**	**1092**	**1077**	**1022**	**72.4**	**40.8**	**554**	**99**	**633**	**46.1**	**20**
48	**1592**	**1211**	**1211**	**1190**	**1190**	**1190**	**1190**	**1190**	**75.0**	**44.2**	**489**	**98**	**747**	**48.9**	**19**
51	1774	1301	1301	1280	1280	1280	1280	1280	77.0	47.6	433	96	868	51.6	18
54	1965	1385	1385	1357	1357	1357	1357	1357	78.5	50.6	390	94	998	54.1	18
57	2145	1458	1458	1425	1425	1425	1425	1425	79.7	53.6	353	92	1132	56.6	17

A-3.2 Stand and stock tables (2.5+)

REF. HEIGHT (m)	STEM COUNT (/ha)	MERCH. VOL. (m^3/ha)	DIAMETER CLASSES (cm)													
			5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
12	3309		1344	1675	287	3											
		40		*15*	*24*	*1*											
21	**2644**		**603**	**704**	**734**	**494**	**109**										
		258		***8***	***86***	***119***	***45***										
30	1216			74	235	272	395	163	77								
		516		*1*	*30*	*78*	*198*	*136*	*73*								
39	**729**						**136**	**183**	**232**	**94**	**84**						
		845					***70***	***160***	***280***	***154***	***181***						
48	489								54	171	138	72	54				
		1190							*83*	*326*	*345*	*230*	*206*				

A-3.3 Maximum mean annual increment (m^3/ha) and culmination age (years: total age)

DBH LIMIT (cm)	SITE INDEX							
	40		**35**		**30**		**25**	
	MAX. MAI	CULM'N AGE	MAX. MAI	CULM'N AGE	MAX. MAI	CULM'N AGE	MAX. MAI	CULM'N AGE
12.5+	16.1	67	12.8	76	9.4	88	6.6	90
17.5+	**16.1**	**67**	**12.8**	**76**	**9.4**	**88**	**6.4**	**94**
22.5+	16.1	67	12.8	76	9.4	88	6.1	110
27.5+	**15.8**	**69**	**12.4**	**84**	**8.8**	**102**	**5.5**	**130**
32.5+	15.6	75	12.0	91	8.1	120	4.7	165

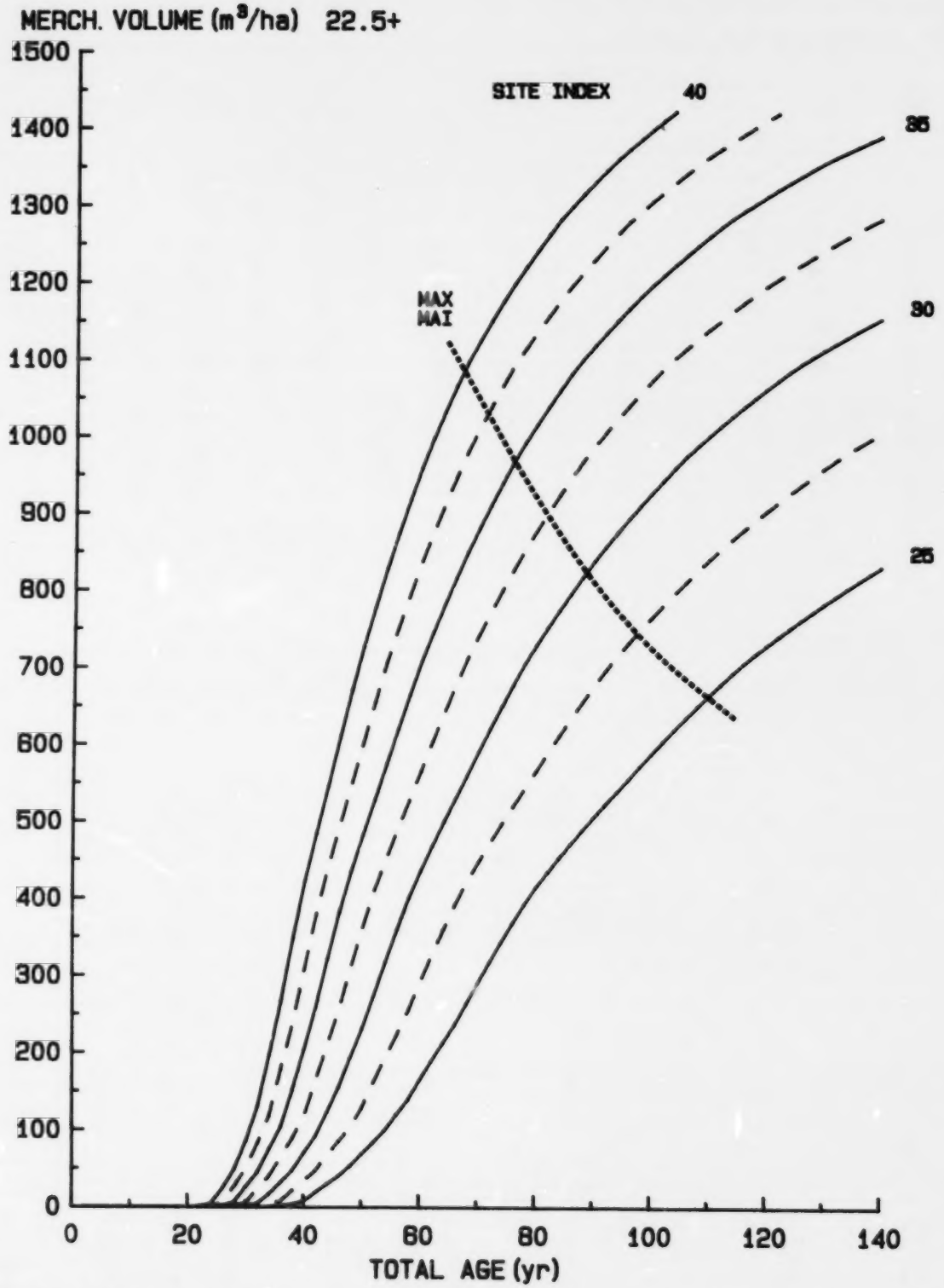

FIGURE A-2. Merchantable volume/age relationship for stands established with 4440 trees/ha, untreated.

MANAGED STAND YIELD TABLES — COASTAL DOUGLAS-FIR

TABLE A-4. Stand established with 4440 trees/ha — precommercially thinned to 1110

A-4.1 Cumulative production

REF. HEIGHT (m)	VOLUME (m^3/ha)								BASAL AREA (m^2/ha)	MEAN DBHg (cm)	STEM COUNT (/ha)	CROWN COVER (%)	250 CROP TREES (12.5+)		
	Gross Prod'n	Total Standing		Merchantable									Merch. Vol. (m^3/ha)	Mean DBHg (cm)	Live Crown (%)
	0.0+	0.0+	7.5+	12.5+	17.5+	22.5+	27.5+	32.5+							
0	0	0	0	0	0	0	0	0	0.0	0.0	4440	0	0	0.0	—
3	2	2	0	0	0	0	0	0	0.4	1.1	4253	48	0	0.0	—
6	17	16	0	0	0	0	0	0	5.3	4.1	4107	89	0	0.0	—
(6)	(17)	(8)	(0)	(0)	(0)	(0)	(0)	(0)	(2.4)	(5.2)	(1110)	(40)	(0)	(0.0)	(—)
9	37	27	25	1	0	0	0	0	7.3	9.3	1075	85	1	12.5	68
12	83	72	72	35	1	0	0	0	14.1	13.0	1060	96	18	15.3	70
15	140	128	128	96	35	0	0	0	20.9	15.9	1053	99	40	18.6	58
18	215	202	202	170	125	0	0	0	27.3	18.2	1053	100	66	21.5	49
21	292	279	279	246	223	77	8	0	32.9	19.9	1053	100	97	24.0	42
24	374	361	361	318	311	175	43	0	38.4	21.8	1028	100	133	26.4	38
27	468	453	453	415	403	323	135	15	44.8	24.0	991	100	174	29.3	35
30	577	553	553	513	507	482	285	87	50.9	26.4	929	100	221	32.0	31
33	705	672	672	630	629	596	469	245	56.8	29.3	840	100	287	35.2	28
36	848	787	787	748	748	744	673	464	62.9	32.3	766	100	363	38.4	26
39	1000	908	908	869	869	869	829	690	68.9	35.5	697	100	449	41.4	24
42	1159	1011	1011	993	993	993	965	882	73.3	38.7	623	100	548	44.4	22
45	1345	1127	1127	1106	1106	1106	1092	1057	76.9	42.0	554	99	652	47.3	21
48	1530	1225	1225	1204	1204	1204	1204	1204	79.0	45.3	489	98	768	50.1	19
51	1708	1326	1326	1290	1290	1290	1290	1290	81.3	48.5	440	97	889	52.7	19
54	1896	1404	1404	1370	1370	1370	1370	1370	82.7	51.6	395	96	1020	55.3	18
57	2075	1476	1476	1448	1448	1448	1448	1448	84.0	54.6	359	95	1156	57.7	17

A-4.2 Stand and stock tables (2.5+)

REF. HEIGHT (m)	STEM COUNT (/ha)	MERCH. VOL. (m^3/ha)	DIAMETER CLASSES (cm)														
			5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
12	1060		15	549	492	4											
		46		*11*	*34*	*1*											
21	1053		15	47	196	810	171	15									
		247		*1*	*23*	*146*	*69*	*8*									
30	929				62	163	356	240	101	7							
		513			*6*	*45*	*177*	*198*	*78*	*9*							
39	697						77	163	240	109	101	7					
		869					*40*	*139*	*287*	*186*	*218*	*19*					
48	489								40	163	156	22	101	7			
		1204							*57*	*306*	*367*	*69*	*374*	*31*			

A-4.3 Maximum mean annual increment (m^3/ha) and culmination age (years: total age)

DBH LIMIT (cm)	SITE INDEX							
	40		35		30		25	
	MAX. MAI	CULM'N AGE	MAX. MAI	CULM'N AGE	MAX. MAI	CULM'N AGE	MAX. MAI	CULM'N AGE
12.5+	16.3	65	13.1	75	9.6	85	6.6	95
17.5+	16.3	65	13.1	75	9.6	85	6.6	95
22.5+	16.3	65	13.1	75	9.6	85	6.4	113
27.5+	16.1	68	12.7	79	9.1	96	5.9	130
32.5+	15.9	74	12.2	92	8.4	115	5.0	160

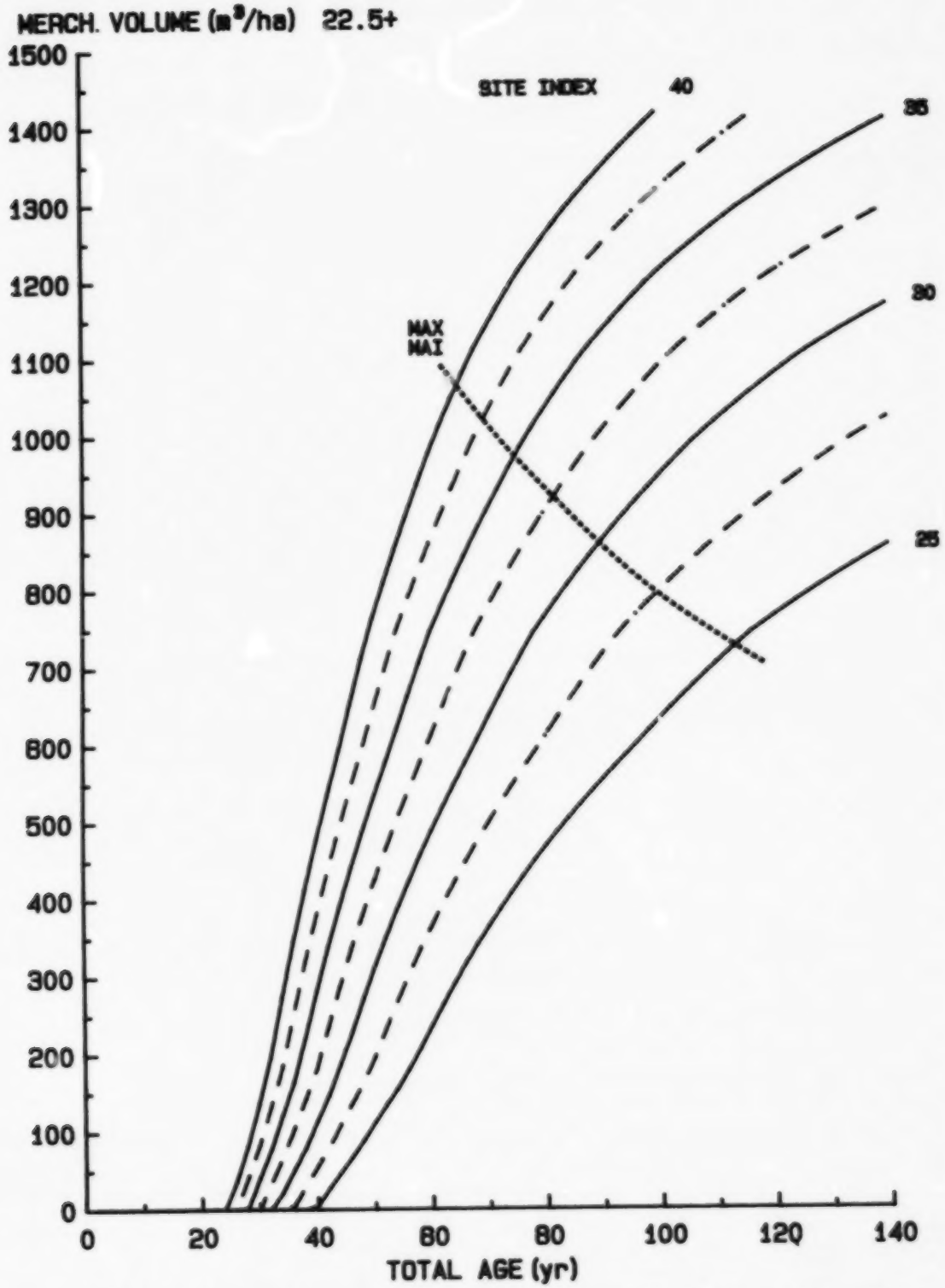

FIGURE A-3. Merchantable volume/age relationship for stands established with 4440 trees/ha, precommercially thinned to 1110.

MANAGED STAND YIELD TABLES — COASTAL DOUGLAS-FIR

TABLE A-5. Stand established with 4440 trees/ha — precommercially thinned to 500

A-5.1 Cumulative production

REF. HEIGHT (m)	VOLUME (m^3/ha)								BASAL AREA (m^2/ha)	MEAN DBHg (cm)	STEM COUNT (/ha)	CROWN COVER (%)	250 CROP TREES (12.5+)		
	Gross Prod'n	Total Standing		Merchantable									Merch. Vol. (m^3/ha)	Mean DBHg (cm)	Live Crown (%)
	0.0+	0.0+	7.5+	12.5+	17.5+	22.5+	27.5+	32.5+							
0	0	0	0	0	0	0	0	0	0.0	0.0	4440	0	0	0.0	—
3	2	2	0	0	0	0	0	0	0.4	1.1	4253	48	0	0.0	—
6	17	16	0	0	0	0	0	0	5.3	4.1	4107	89	0	0.0	—
(6)	(17)	(4)	(0)	(0)	(0)	(0)	(0)	(0)	(1.2)	(5.6)	(500)	(20)	(0)	(0.0)	(—)
9	29	14	14	1	0	0	0	0	4.1	10.3	494	56	1	12.6	68
12	58	43	43	30	10	0	0	0	9.1	15.4	490	80	21	16.4	70
15	98	83	83	70	55	13	0	0	14.2	19.3	487	93	48	20.9	70
18	157	142	142	128	125	74	14	0	19.5	22.6	487	97	82	24.6	62
21	221	206	206	190	188	160	82	6	24.2	25.1	487	99	124	27.8	54
24	292	277	277	259	257	245	147	52	29.3	27.7	487	100	171	30.7	47
27	375	360	360	339	339	334	268	154	35.5	30.5	487	100	223	34.0	41
30	470	455	455	429	429	424	408	290	42.7	33.5	486	100	281	37.0	36
33	585	566	566	540	540	540	523	422	49.8	36.2	483	100	360	40.5	33
36	716	697	697	667	667	667	663	635	57.4	39.1	478	100	446	43.8	30
39	858	834	834	802	802	802	798	770	65.5	42.0	472	100	543	46.9	27
42	1007	982	982	947	947	947	942	920	73.2	45.0	461	100	651	50.0	25
45	1172	1127	1127	1085	1085	1085	1085	1072	79.8	48.1	438	99	786	52.8	23
48	1343	1239	1239	1204	1204	1204	1204	1204	83.7	51.3	405	98	890	55.6	22
51	1512	1342	1342	1307	1307	1307	1307	1307	86.5	54.5	371	97	1022	58.2	21
54	1688	1439	1439	1403	1403	1403	1403	1403	89.3	57.7	341	96	1160	60.8	20
57	1858	1518	1518	1504	1504	1504	1504	1504	91.1	60.6	316	95	1304	63.1	19

A-5.2 Stand and stock tables (2.5+)

REF. HEIGHT (m)	STEM COUNT (/ha)	MERCH. VOL. (m^3/ha)	DIAMETER CLASSES (cm)														
			5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
12	490			93	365	32											
		31		*1*	*20*	*10*											
21	487				15	109	218	138	7								
		190			*2*	*28*	*78*	*76*	*6*								
30	486					15	40	194	95	135	7						
		429				*5*	*18*	*126*	*91*	*176*	*13*						
39	472						7	32	116	124	69	109	15				
		802					*4*	*28*	*136*	*190*	*138*	*261*	*45*				
48	405								33	45	105	60	81	74	7		
		1204							*30*	*85*	*248*	*176*	*292*	*332*	*41*		

A-5.3 Maximum mean annual increment (m^3/ha) and culmination age (years: total age)

DBH LIMIT (cm)	SITE INDEX							
	40		35		30		25	
	MAX. MAI	CULM'N AGE	MAX. MAI	CULM'N AGE	MAX. MAI	CULM'N AGE	MAX. MAI	CULM'N AGE
12.5+	16.0	69	12.5	83	8.9	97	5.8	111
17.5+	16.0	69	12.5	83	8.9	97	5.8	111
22.5+	16.0	69	12.5	83	8.9	97	5.8	111
27.5+	16.0	69	12.5	84	8.8	100	5.7	118
32.5+	15.8	71	12.3	87	8.6	105	5.6	125

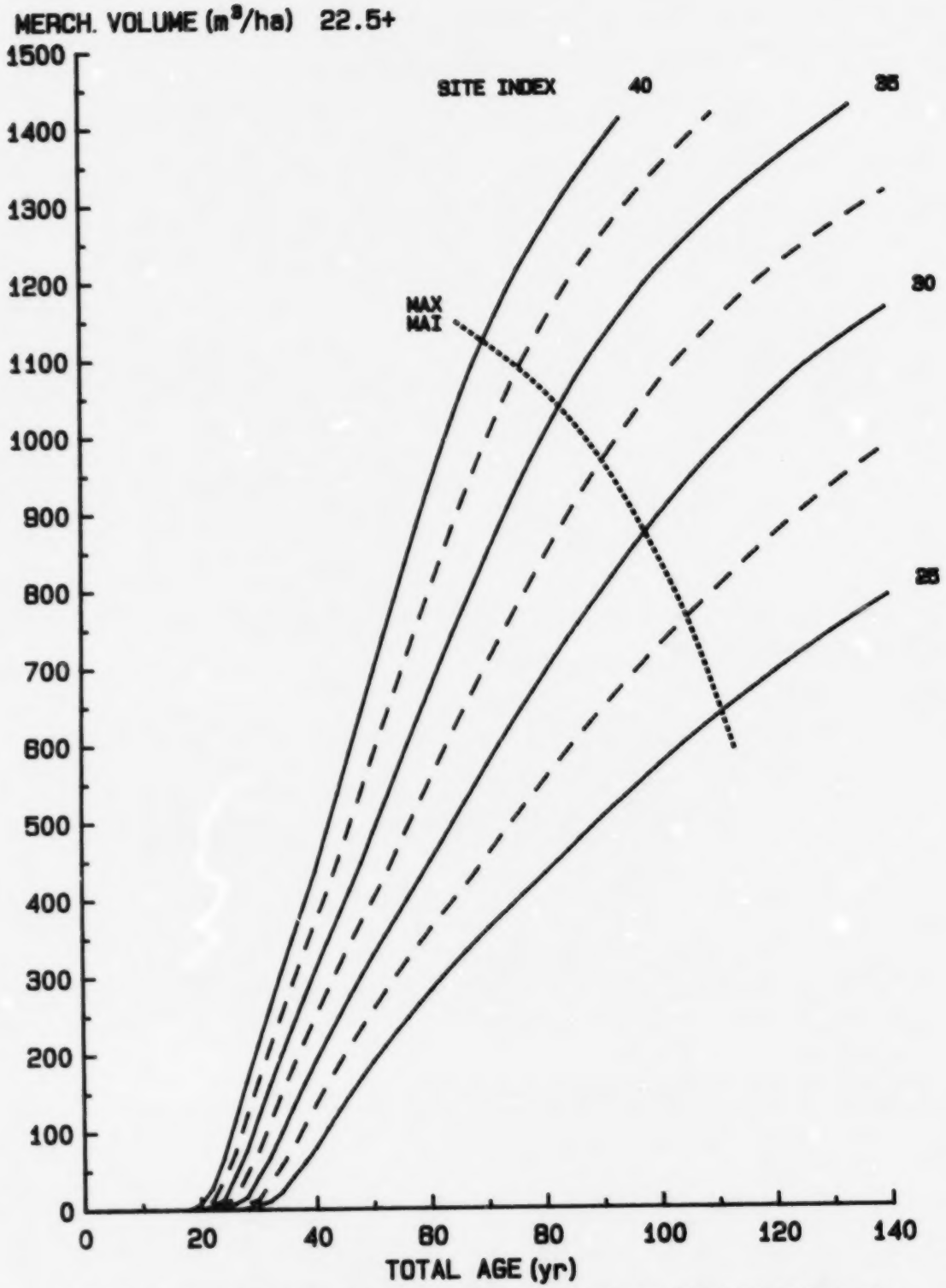

FIGURE A-4. Merchantable volume/age relationship for stands established with 4440 trees/ha, precommercially thinned to 500.

MANAGED STAND YIELD TABLES — COASTAL DOUGLAS-FIR

TABLE A-6. Stand planted with 2500 trees/ha — untreated

A-6.1 Cumulative production

REF. HEIGHT (m)	VOLUME (m^3/ha)								BASAL AREA (m^2/ha)	MEAN DBHg (cm)	STEM COUNT (/ha)	CROWN COVER (%)	250 CROP TREES (12.5+)		
	Gross Prod'n	Total Standing		Merchantable									Merch. Vol. (m^3/ha)	Mean DBHg (cm)	Live Crown (%)
	0.0+	0.0+	7.5+	12.5+	17.5+	22.5+	27.5+	32.5+							
0	0	0	0	0	0	0	0	0	0.0	0.0	2500	0	0	0.0	—
3	1	1	0	0	0	0	0	0	0.3	1.2	2394	37	0	0.0	—
6	13	13	0	0	0	0	0	0	4.9	5.2	2310	88	0	0.0	—
(6)				(U N T R E A T E D)											
9	**43**	**42**	**35**	**1**	**0**	**0**	**0**	**0**	**13.0**	**8.6**	**2254**	**98**	**1**	**13.3**	**68**
12	**100**	**97**	**95**	**27**	**0**	**0**	**0**	**0**	**21.1**	**11.0**	**2217**	**99**	**13**	**14.0**	**64**
15	164	161	160	79	7	0	0	0	28.7	12.9	2207	100	30	16.8	52
18	243	240	239	161	75	3	0	0	34.6	14.2	2199	100	50	19.3	45
21	324	320	319	242	159	22	5	0	40.8	15.4	2184	100	76	21.6	40
24	**407**	**400**	**400**	**324**	**248**	**84**	**9**	**3**	**45.6**	**16.9**	**2024**	**100**	**107**	**23.9**	**37**
27	**509**	**481**	**481**	**412**	**357**	**230**	**46**	**9**	**50.0**	**19.6**	**1657**	**100**	**145**	**26.8**	**33**
30	**618**	**559**	**559**	**509**	**470**	**390**	**186**	**26**	**54.0**	**23.0**	**1299**	**100**	**189**	**29.7**	**30**
33	746	649	649	606	587	537	384	124	57.5	26.4	1050	100	251	33.0	28
36	889	757	757	716	712	682	569	337	61.0	29.9	870	100	322	36.2	26
39	1039	866	866	826	825	810	755	559	64.9	33.3	746	100	402	39.3	23
42	**1201**	**966**	**966**	**931**	**931**	**931**	**913**	**770**	**68.0**	**36.6**	**647**	**100**	**492**	**42.2**	**22**
45	**1381**	**1057**	**1057**	**1029**	**1029**	**1029**	**1020**	**966**	**71.2**	**40.1**	**585**	**99**	**588**	**45.1**	**20**
48	**1565**	**1154**	**1154**	**1120**	**1120**	**1120**	**1120**	**1090**	**73.8**	**43.6**	**494**	**98**	**692**	**47.8**	**19**
51	1740	1239	1239	1205	1205	1205	1205	1205	75.8	47.0	437	96	803	50.4	18
54	1920	1315	1315	1294	1294	1294	1294	1294	77.5	50.3	390	94	922	52.8	17
57	2096	1392	1392	1371	1371	1371	1371	1371	79.0	53.0	358	92	1045	55.2	17

A-6.2 Stand and stock tables (2.5+)

REF. HEIGHT (m)	STEM COUNT (/ha)	MERCH. VOL. (m^3/ha)	DIAMETER CLASSES (cm)														
			5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
12	2217		146	1668	403												
		47		*20*	*27*												
21	**2184**		**96**	**598**	**848**	**586**	**49**	**7**									
		250		***8***	***83***	***137***	***17***	***5***									
30	1299			6	289	325	425	232	15	5	2						
		509			*39*	*80*	*204*	*160*	*14*	*8*	*4*						
39	**746**				**7**	**35**	**94**	**230**	**237**	**110**	**26**	**5**	**2**				
		826			***1***	***15***	***55***	***196***	***297***	***180***	***58***	***16***	***8***				
48	494							30	55	138	195	42	27	5	2		
		1120						*30*	*82*	*267*	*470*	*130*	*100*	*28*	*13*		

A-6.3 Maximum mean annual increment (m^3/ha) and culmination age (years: total age)

DBH LIMIT (cm)	SITE INDEX							
	40		35		30		25	
	MAX. MAI	CULM'N AGE	MAX. MAI	CULM'N AGE	MAX. MAI	CULM'N AGE	MAX. MAI	CULM'N AGE
12.5+	15.3	60	12.3	71	9.1	78	6.5	80
17.5+	**15.3**	**60**	**12.3**	**72**	**9.1**	**85**	**6.2**	**100**
22.5+	15.3	61	12.2	75	8.9	91	5.9	118
27.5+	**15.0**	**66**	**12.0**	**78**	**8.5**	**105**	**5.3**	**145**
32.5+	14.7	75	11.4	95	7.8	132	4.1	180

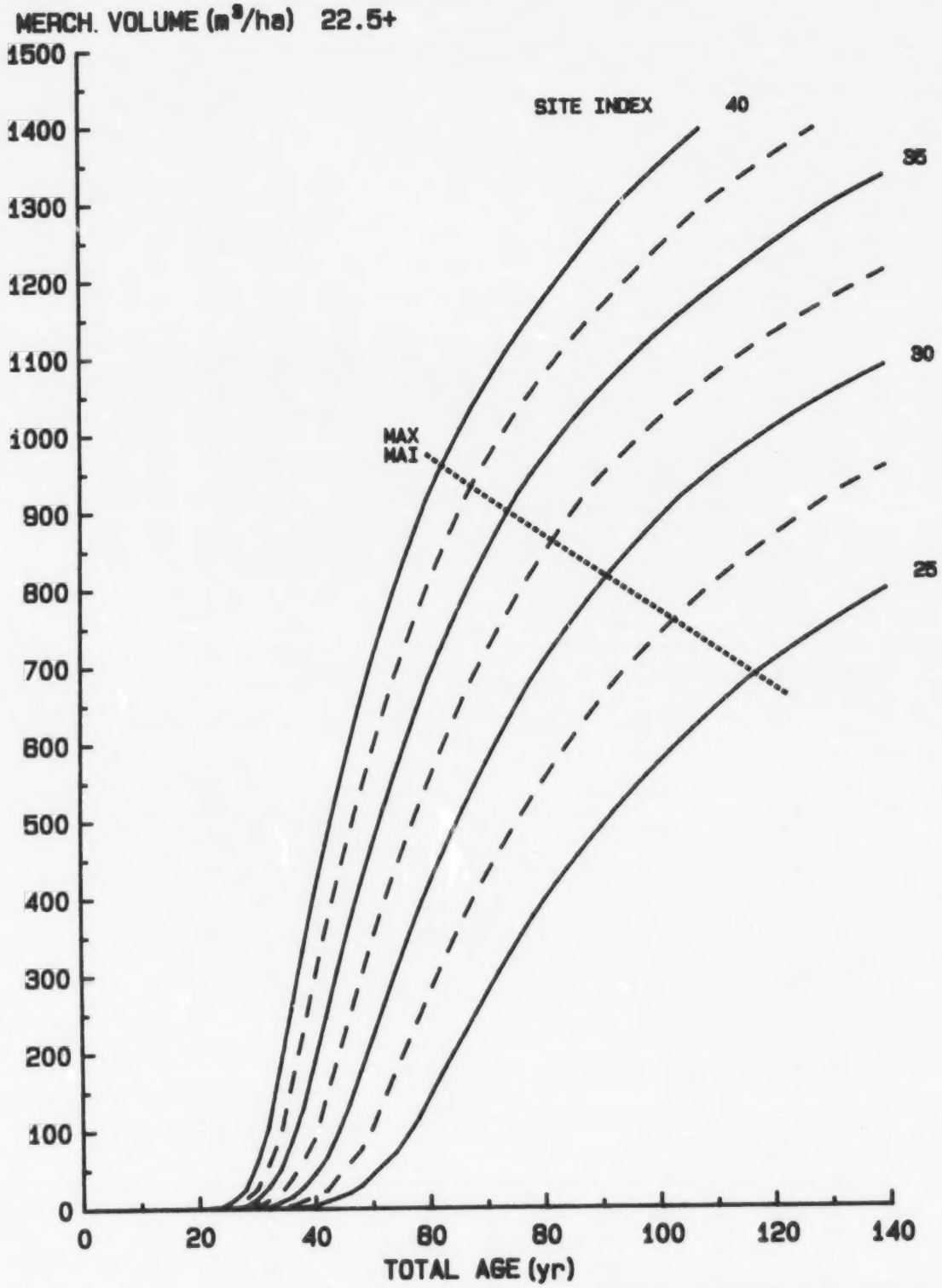

FIGURE A-5. Merchantable volume/age relationship for stands planted with 2500 trees/ha, untreated.

MANAGED STAND YIELD TABLES — COASTAL DOUGLAS-FIR

TABLE A-7. Stand planted with 2500 trees/ha — precommercially thinned to 1110

A-7.1 Cumulative production

REF. HEIGHT (m)	VOLUME (m^3/ha)								BASAL AREA (m^2/ha)	MEAN DBHg (cm)	STEM COUNT (/ha)	CROWN COVER (%)	250 CROP TREES (12.5+)		
	Gross Prod'n	Total Standing		Merchantable									Merch. Vol. (m^3/ha)	Mean DBHg (cm)	Live Crown (%)
	0.0+	0.0+	7.5+	12.5+	17.5+	22.5+	27.5+	32.5+							
0	0	0	0	0	0	0	0	0	0.0	0.0	2500	0	0	0.0	—
3	1	1	0	0	0	0	0	0	0.3	1.2	2394	37	0	0.0	—
6	13	13	0	0	0	0	0	0	4.9	5.2	2310	88	0	0.0	—
(8)	(13)	(8)	(0)	(0)	(0)	(0)	(0)	(0)	(2.8)	(5.7)	(1110)	(53)	(0)	(0.0)	(—)
9	**34**	**28**	**28**	**1**	**0**	**0**	**0**	**0**	**8.1**	**9.7**	**1092**	**90**	**1**	**13.8**	**68**
12	**80**	**72**	**72**	**39**	**1**	**0**	**0**	**0**	**14.5**	**13.1**	**1077**	**96**	**17**	**15.0**	**69**
15	136	128	128	97	37	2	0	0	21.6	16.0	1072	99	36	18.4	58
18	210	202	202	170	130	13	3	0	28.2	18.3	1072	100	60	21.2	49
21	285	277	277	244	220	75	5	0	33.9	20.1	1072	100	89	23.6	42
24	**369**	**361**	**361**	**325**	**309**	**172**	**19**	**7**	**39.9**	**21.8**	**1065**	**100**	**121**	**25.8**	**37**
27	**466**	**458**	**456**	**416**	**404**	**316**	**104**	**9**	**46.0**	**23.8**	**1038**	**100**	**158**	**28.5**	**34**
30	**577**	**562**	**562**	**520**	**515**	**464**	**276**	**50**	**53.0**	**26.2**	**991**	**100**	**203**	**31.2**	**30**
33	707	672	672	637	635	597	463	220	58.9	28.6	927	100	264	34.4	28
36	851	791	791	754	754	740	657	430	64.5	31.4	837	100	334	37.4	25
39	1009	896	896	847	847	843	812	629	68.4	34.4	735	100	413	40.3	23
42	**1164**	**993**	**993**	**945**	**945**	**945**	**945**	**840**	**71.5**	**37.7**	**640**	**100**	**501**	**43.2**	**22**
45	**1347**	**1085**	**1085**	**1043**	**1043**	**1043**	**1043**	**994**	**74.0**	**41.0**	**560**	**99**	**597**	**46.0**	**20**
48	**1532**	**1176**	**1176**	**1130**	**1130**	**1130**	**1130**	**1130**	**76.3**	**44.6**	**489**	**98**	**700**	**48.6**	**19**
51	1706	1253	1253	1225	1225	1225	1225	1225	78.3	48.0	432	97	810	51.1	18
54	1888	1329	1329	1319	1319	1319	1319	1319	80.2	51.2	390	95	929	53.6	17
57	2067	1392	1392	1399	1399	1399	1399	1399	81.5	53.8	359	93	1052	55.9	17

A-7.2 Stand and stock tables (2.5+)

REF. HEIGHT (m)	STEM COUNT (/ha)	MERCH. VOL. (m^3/ha)	DIAMETER CLASSES (cm)														
			5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
12	1077			445	625	7											
		46		*7*	*38*	*1*											
21	**1072**			**27**	**218**	**625**	**195**	**7**									
		245		***1***	***24***	***145***	***70***	***5***									
30	991				34	188	395	325	42	0	7						
		520			*5*	*51*	*186*	*228*	*38*	*0*	*12*						
39	**735**					**15**	**82**	**206**	**201**	**203**	**42**	**0**	**7**				
		847				***4***	***31***	***183***	***222***	***298***	***85***	***0***	***24***				
48	489								57	131	203	62	27	2	0	7	
		1130							*78*	*244*	*470*	*187*	*102*	*8*	*0*	*41*	

A-7.3 Maximum mean annual increment (m^3/ha) and culmination age (years: total age)

DBH LIMIT (cm)	SITE INDEX							
	40		35		30		25	
	MAX. MAI	CULM'N AGE	MAX. MAI	CULM'N AGE	MAX. MAI	CULM'N AGE	MAX. MAI	CULM'N AGE
12.5+	15.6	54	12.6	66	9.5	78	6.7	90
17.5+	**15.6**	**54**	**12.6**	**66**	**9.5**	**78**	**6.7**	**90**
22.5+	15.5	55	12.5	69	9.4	84	6.4	110
27.5+	**15.3**	**64**	**12.3**	**76**	**9.2**	**92**	**5.9**	**130**
32.5+	14.9	76	11.4	97	7.6	128	4.6	192

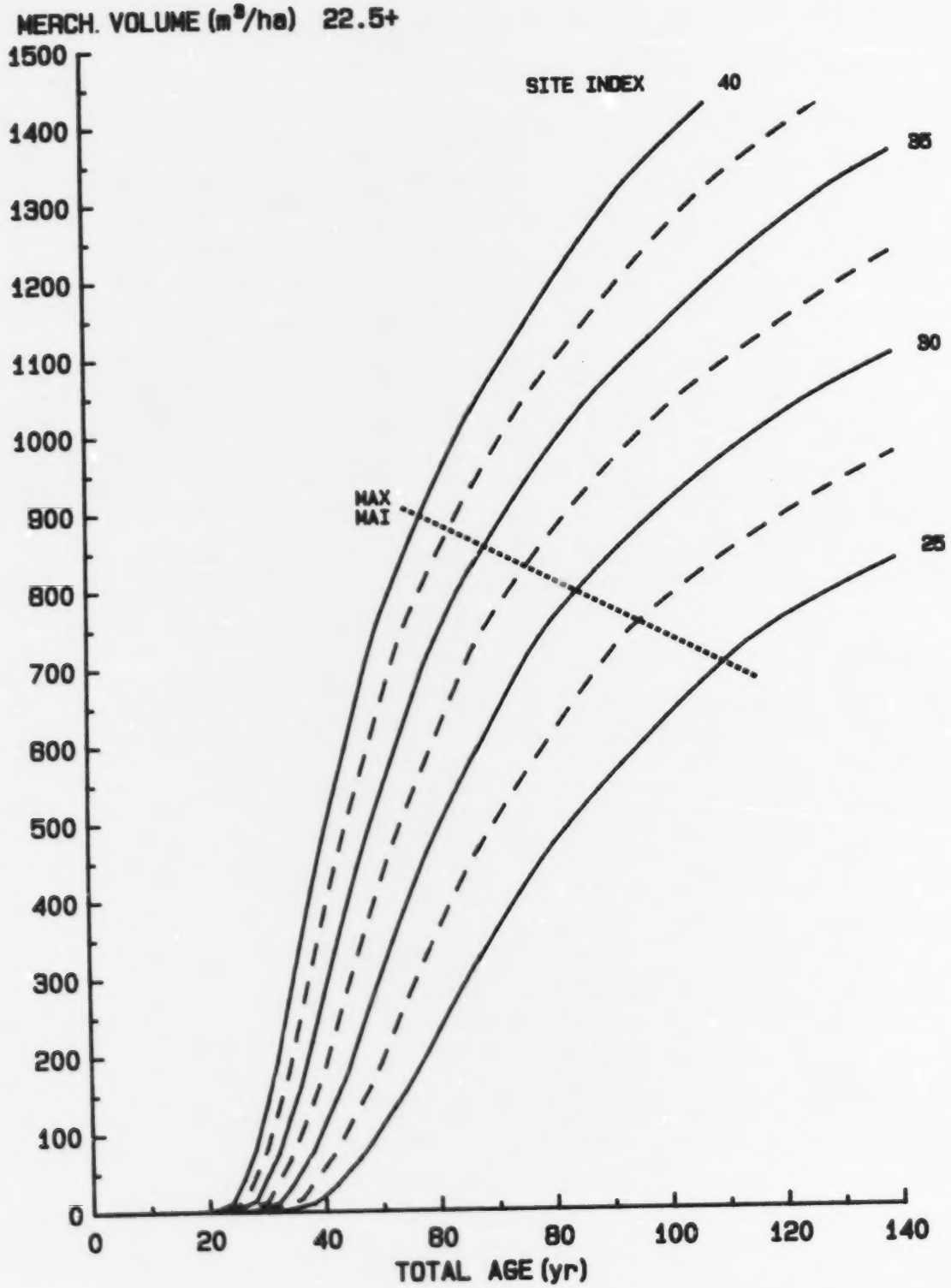

FIGURE A-6. Merchantable volume/age relationship for stands planted with 2500 trees/ha, precommercially thinned to 1110.

MANAGED STAND YIELD TABLES — COASTAL DOUGLAS-FIR

TABLE A-8. Stand planted with 2500 trees/ha — precommercially thinned to 500

A-8.1 Cumulative production

REF. HEIGHT (m)	VOLUME (m^3/ha)								BASAL AREA (m^2/ha)	MEAN DBHq (cm)	STEM COUNT (/ha)	CROWN COVER (%)	250 CROP TREES (12.5+)		
	Gross Prod'n	Total Standing		Merchantable									Merch. Vol. (m^3/ha)	Mean DBHq (cm)	Live Crown (%)
	0.0+	0.0+	7.5+	12.5+	17.5+	22.5+	27.5+	32.5+							
0	0	0	0	0	0	0	0	0	0.0	0.0	2500	0	0	0.0	—
3	1	1	0	0	0	0	0	0	0.3	1.2	2394	37	0	0.0	—
6	13	13	0	0	0	0	0	0	4.9	5.2	2310	88	0	0.0	—
(6)	(13)	(4)	(0)	(0)	(0)	(0)	(0)	(0)	(1.4)	(6.0)	(500)	(27)	(0)	(0.0)	(—)
9	**26**	**15**	**15**	**1**	**0**	**0**	**0**	**0**	**4.5**	**10.9**	**487**	**58**	**1**	**13.4**	**68**
12	**55**	**44**	**44**	**29**	**2**	**0**	**0**	**0**	**9.0**	**15.4**	**487**	**83**	**19**	**18.2**	**69**
15	95	84	84	71	64	5	0	0	14.2	19.3	487	95	44	20.6	71
18	142	141	141	130	130	81	10	0	19.5	22.6	487	99	76	24.3	63
21	216	207	207	191	191	175	42	6	24.7	25.4	487	100	115	27.3	53
24	**289**	**278**	**278**	**260**	**260**	**246**	**149**	**25**	**29.9**	**27.9**	**487**	**100**	**158**	**30.1**	**46**
27	**373**	**362**	**362**	**340**	**340**	**340**	**297**	**105**	**36.1**	**30.7**	**487**	**100**	**207**	**33.2**	**40**
30	**469**	**458**	**458**	**434**	**434**	**434**	**416**	**304**	**43.3**	**33.7**	**487**	**100**	**261**	**36.2**	**35**
33	585	574	574	548	548	548	543	486	51.2	36.6	487	100	334	39.5	32
36	717	707	707	677	677	677	677	637	58.5	39.1	487	100	413	42.6	28
39	857	846	846	807	807	807	807	782	66.9	41.8	487	100	501	45.6	26
42	**1013**	**1002**	**1002**	**966**	**966**	**966**	**966**	**966**	**74.8**	**44.4**	**482**	**100**	**596**	**48.5**	**24**
45	**1182**	**1148**	**1148**	**1099**	**1099**	**1099**	**1099**	**1099**	**81.5**	**47.2**	**485**	**99**	**701**	**51.2**	**22**
48	**1357**	**1260**	**1260**	**1223**	**1223**	**1223**	**1223**	**1223**	**85.5**	**49.9**	**437**	**97**	**811**	**53.7**	**20**
51	1530	1379	1379	1341	1341	1341	1341	1341	89.9	52.7	410	96	928	56.2	19
54	1708	1473	1473	1436	1436	1436	1436	1436	92.7	55.4	385	95	1049	58.5	18
57	1881	1576	1576	1539	1539	1530	1539	1539	95.5	57.9	363	94	1175	60.7	17

A-8.2 Stand and stock tables (2.5+)

REF. HEIGHT (m)	STEM COUNT (/ha)	MERCH. VOL. (m^3/ha)	DIAMETER CLASSES (cm)														
			5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
12	487			35	437	15											
		30		*1*	*27*	*2*											
21	**487**					**62**	**348**	**70**	**7**								
		191				***16***	***133***	***36***	***6***								
30	487						42	146	235	57	7						
		434					*18*	*112*	*221*	*70*	*13*						
39	**487**							**27**	**89**	**196**	**133**	**49**	**7**	**7**			
		807						***25***	***81***	***296***	***249***	***113***	***18***	***25***			
48	437								15	42	117	144	77	30	7	5	
		1223							*21*	*76*	*280*	*407*	*255*	*115*	*38*	*31*	

A-8.3 Maximum mean annual increment (m^3/ha) and culmination age (years: total age)

DBH LIMIT (cm)	SITE INDEX							
	40		35		30		25	
	MAX. MAI	CULM'N AGE	MAX. MAI	CULM'N AGE	MAX. MAI	CULM'N AGE	MAX. MAI	CULM'N AGE
12.5+	16.2	71	12.7	81	9.1	96	5.8	115
17.5+	16.2	71	12.7	81	9.1	96	5.8	115
22.5+	16.2	71	12.7	81	9.1	96	5.8	115
27.5+	16.2	71	12.7	81	9.1	96	5.8	115
32.5+	16.2	71	12.7	81	9.0	101	5.5	125

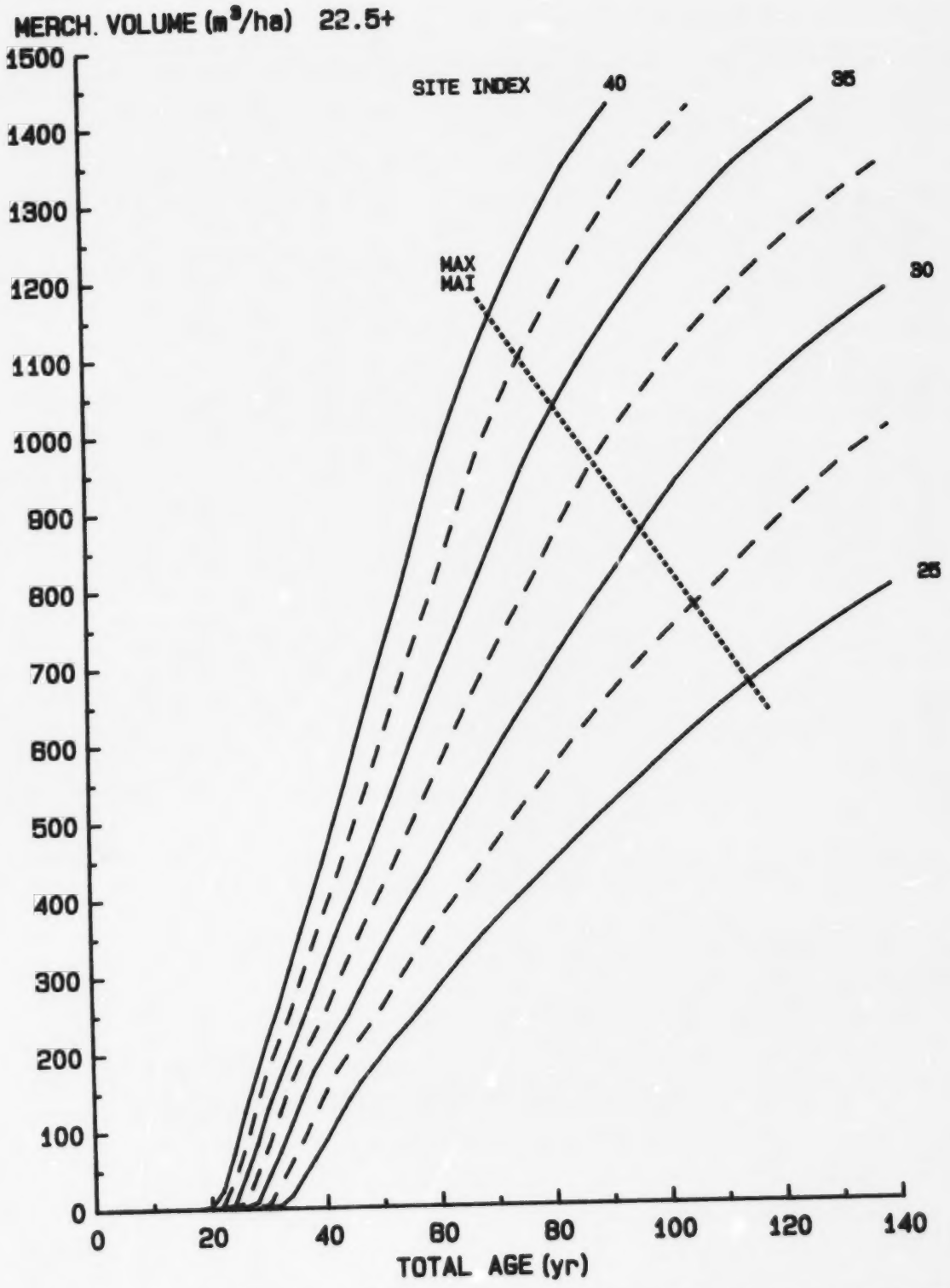

FIGURE A-7. Merchantable volume/age relationship for stands planted with 2500 trees/ha, precommercially thinned to 500.

MANAGED STAND YIELD TABLES — COASTAL DOUGLAS-FIR

TABLE A-9. Stand planted with 1110 trees/ha — untreated

A-9.1 Cumulative production

REF. HEIGHT (m)	VOLUME (m³/ha)								BASAL AREA (m²/ha)	MEAN DBHg (cm)	STEM COUNT (/ha)	CROWN COVER (%)	250 CROP TREES (12.5+)		
	Gross Prod'n	Total Standing		Merchantable									Merch. Vol. (m³/ha)	Mean DBHg (cm)	Live Crown (%)
	0.0+	0.0+	7.5+	12.5+	17.5+	22.5+	27.5+	32.5+							
0	0	0	0	0	0	0	0	0	0.0	0.0	1110	0	0	0.0	—
3	1	1	0	0	0	0	0	0	0.1	1.2	1058	16	0	0.0	—
6	6	6	0	0	0	0	0	0	2.6	5.7	1017	60	0	0.0	—
(6)	(U N T R E A T E D)														
9	23	22	22	1	0	0	0	0	7.7	9.9	996	92	1	13.1	89
12	62	60	60	22	1	0	0	0	12.8	12.9	986	96	17	15.5	89
15	111	109	109	83	34	2	0	0	20.0	16.1	979	99	37	19.0	82
18	175	173	173	147	112	26	0	0	26.2	18.5	979	100	62	21.9	52
21	247	245	245	216	197	86	11	0	32.5	20.6	979	100	91	24.4	45
24	326	324	324	293	283	167	44	0	38.4	22.3	979	100	125	26.8	40
27	419	417	417	382	377	294	136	19	45.2	24.3	974	100	184	29.6	36
30	526	523	523	483	479	433	299	112	53.0	26.8	954	100	210	32.4	32
33	651	638	638	597	596	567	444	244	58.6	29.0	888	100	272	35.5	29
36	788	756	756	726	726	707	603	414	64.0	31.6	815	100	342	38.6	27
39	930	860	860	822	822	815	749	576	68.3	34.5	729	100	422	41.6	25
42	1086	955	955	920	920	918	892	759	72.4	37.9	640	100	512	44.5	23
45	1252	1043	1043	1004	1004	1004	997	917	75.3	41.3	582	99	609	47.3	22
48	1422	1127	1127	1085	1085	1085	1085	1072	77.2	44.8	489	98	714	50.0	21
51	1596	1202	1202	1167	1167	1167	1167	1167	79.0	48.3	431	96	827	52.6	20
54	1780	1273	1273	1232	1232	1232	1232	1232	80.1	51.1	390	94	947	55.1	20
57	1918	1342	1342	1310	1310	1310	1310	1310	81.1	54.1	353	92	1074	57.6	19

A-9.2 Stand and stock tables (2.5+)

REF. HEIGHT (m)	STEM COUNT (/ha)	MERCH. VOL. (m³/ha)	DIAMETER CLASSES (cm)														
			5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
12	986			500	479	7											
		38		*16*	*21*	*1*											
21	979			7	190	552	210	20									
		216			*19*	*111*	*75*	*11*									
30	954				40	190	375	230	99	20							
		483			*4*	*46*	*164*	*157*	*89*	*23*							
39	729					27	118	229	158	105	73	19					
		822				*7*	*66*	*173*	*201*	*180*	*146*	*49*					
48	489							12	71	138	111	91	47	12	7		
		1085						*13*	*82*	*240*	*242*	*263*	*158*	*58*	*29*		

A-9.3 Maximum mean annual increment (m³/ha) and culmination age (years: total age)

DBH LIMIT (cm)	SITE INDEX							
	40		35		30		25	
	MAX. MAI	CULM'N AGE	MAX. MAI	CULM'N AGE	MAX. MAI	CULM'N AGE	MAX. MAI	CULM'N AGE
12.5+	15.1	58	12.2	71	9.2	83	6.3	96
17.5+	15.1	58	12.2	71	9.2	83	6.3	96
22.5+	15.0	59	12.1	75	9.1	85	6.1	110
27.5+	14.7	65	11.8	80	8.3	100	5.4	132
32.5+	14.1	77	10.8	99	7.2	130	4.2	180

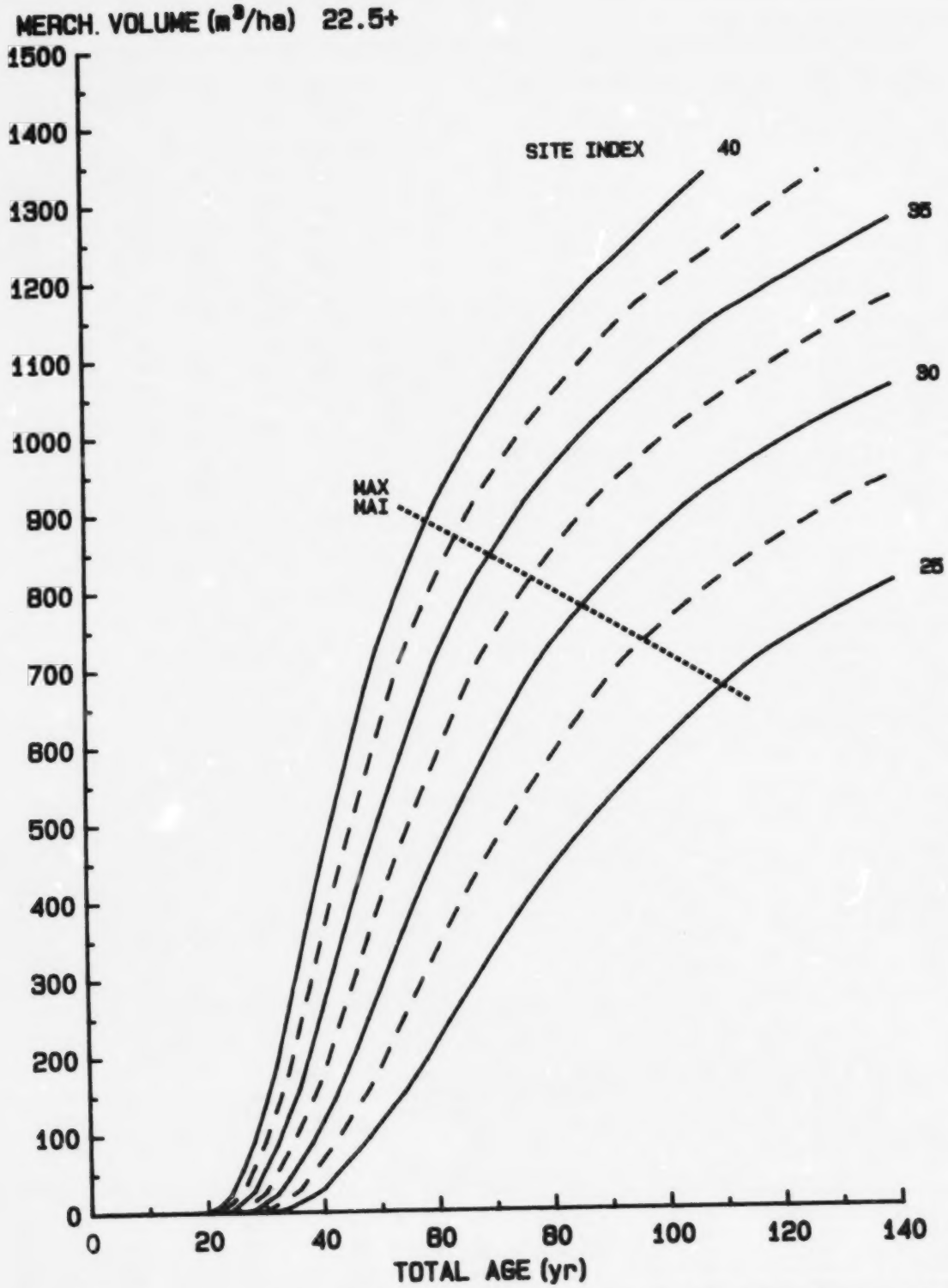

FIGURE A-8. Merchantable volume/age relationship for stands planted with 1110 trees/ha, untreated.

MANAGED STAND YIELD TABLES — COASTAL DOUGLAS-FIR

TABLE A-10. Stand planted with 1110 trees/ha — precommercially thinned to 500

A-10.1 Cumulative production

REF. HEIGHT (m)	VOLUME (m³/ha)								BASAL AREA (m²/ha)	MEAN DBHg (cm)	STEM COUNT (/ha)	CROWN COVER (%)	250 CROP TREES (12.5+)		
	Gross Prod'n	Total Standing		Merchantable									Merch. Vol. (m³/ha)	Mean DBHg (cm)	Live Crown (%)
	0.0+	0.0+	7.5+	12.5+	17.5+	22.5+	27.5+	32.5+							
0	0	0	0	0	0	0	0	0	0.0	0.0	1110	0	0	0.0	—
3	1	1	0	0	0	0	0	0	0.1	1.2	1058	16	0	0.0	—
6	6	6	0	0	0	0	0	0	2.6	5.7	1017	60	0	0.0	—
(6)	(6)	(4)	(0)	(0)	(0)	(0)	(0)	(0)	(1.5)	(6.1)	(500)	(33)	(0)	(0.0)	(—)
9	**17**	**13**	**13**	**1**	**0**	**0**	**0**	**0**	**4.4**	**10.7**	**487**	**61**	**1**	**13.1**	**68**
12	**41**	**37**	**37**	**26**	**2**	**0**	**0**	**0**	**8.6**	**15.1**	**479**	**81**	**18**	**18.2**	**69**
15	77	73	73	61	50	6	0	0	13.4	19.0	472	93	41	20.5	71
18	128	124	124	113	112	70	9	0	18.5	22.4	472	98	72	24.2	64
21	189	185	185	170	170	145	53	9	23.4	25.2	472	99	110	27.3	55
24	**256**	**252**	**252**	**235**	**235**	**228**	**141**	**28**	**28.9**	**27.9**	**472**	**100**	**154**	**30.1**	**49**
27	**337**	**333**	**333**	**312**	**312**	**310**	**259**	**113**	**35.3**	**30.9**	**472**	**100**	**203**	**33.4**	**43**
30	**429**	**425**	**425**	**402**	**402**	**402**	**387**	**283**	**42.3**	**33.8**	**472**	**100**	**258**	**36.5**	**37**
33	540	536	536	510	510	510	501	435	50.5	36.9	472	100	333	40.0	34
36	663	659	659	630	630	630	628	584	58.2	39.6	472	100	414	43.2	31
39	792	788	788	756	756	756	753	742	66.3	42.3	472	100	504	46.3	28
42	**935**	**928**	**928**	**892**	**892**	**892**	**892**	**878**	**74.1**	**45.0**	**467**	**100**	**603**	**49.3**	**26**
45	**1089**	**1036**	**1036**	**1001**	**1001**	**1001**	**1001**	**990**	**77.0**	**48.0**	**425**	**99**	**709**	**52.1**	**24**
48	**1247**	**1133**	**1133**	**1098**	**1098**	**1098**	**1098**	**1098**	**80.2**	**51.3**	**388**	**98**	**823**	**54.8**	**23**
51	1402	1219	1219	1197	1197	1197	1197	1197	82.2	54.2	356	97	943	57.4	21
54	1560	1326	1326	1291	1291	1291	1291	1291	84.0	57.3	329	96	1070	59.9	21
57	1716	1406	1406	1371	1371	1371	1371	1371	85.0	59.9	301	95	1202	62.2	20

A-10.2 Stand and stock tables (2.5+)

REF. HEIGHT (m)	STEM COUNT (/ha)	MERCH. VOL. (m³/ha)	DIAMETER CLASSES (cm)														
			5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
12	479			59	400	20											
		27		*1*	*24*	*2*											
21	**472**					**106**	**268**	**86**	**12**								
		170				***25***	***92***	***44***	***9***								
30	472						32	145	189	86	20						
		402					*15*	*104*	*157*	*95*	*31*						
39	**472**						**7**	**20**	**98**	**170**	**78**	**72**	**20**	**7**			
		756					***3***	***11***	***105***	***249***	***145***	***164***	***55***	***24***			
48	388								5	22	119	119	52	52	12	7	
		1098							*5*	*39*	*248*	*317*	*176*	*212*	*54*	*47*	

A-10.3 Maximum mean annual increment (m^3/ha) and culmination age (years: total age)

DBH LIMIT (cm)	SITE INDEX							
	40		35		30		25	
	MAX. MAI	CULM'N AGE	MAX. MAI	CULM'N AGE	MAX. MAI	CULM'N AGE	MAX. MAI	CULM'N AGE
12.5+	14.7	65	11.7	78	8.4	96	5.4	120
17.5+	**14.7**	**65**	**11.7**	**78**	**8.4**	**96**	**5.4**	**120**
22.5+	14.7	65	11.7	78	8.4	96	5.4	120
27.5+	**14.7**	**65**	**11.7**	**78**	**8.4**	**96**	**5.4**	**120**
32.5+	14.7	66	11.5	80	8.3	98	5.3	125

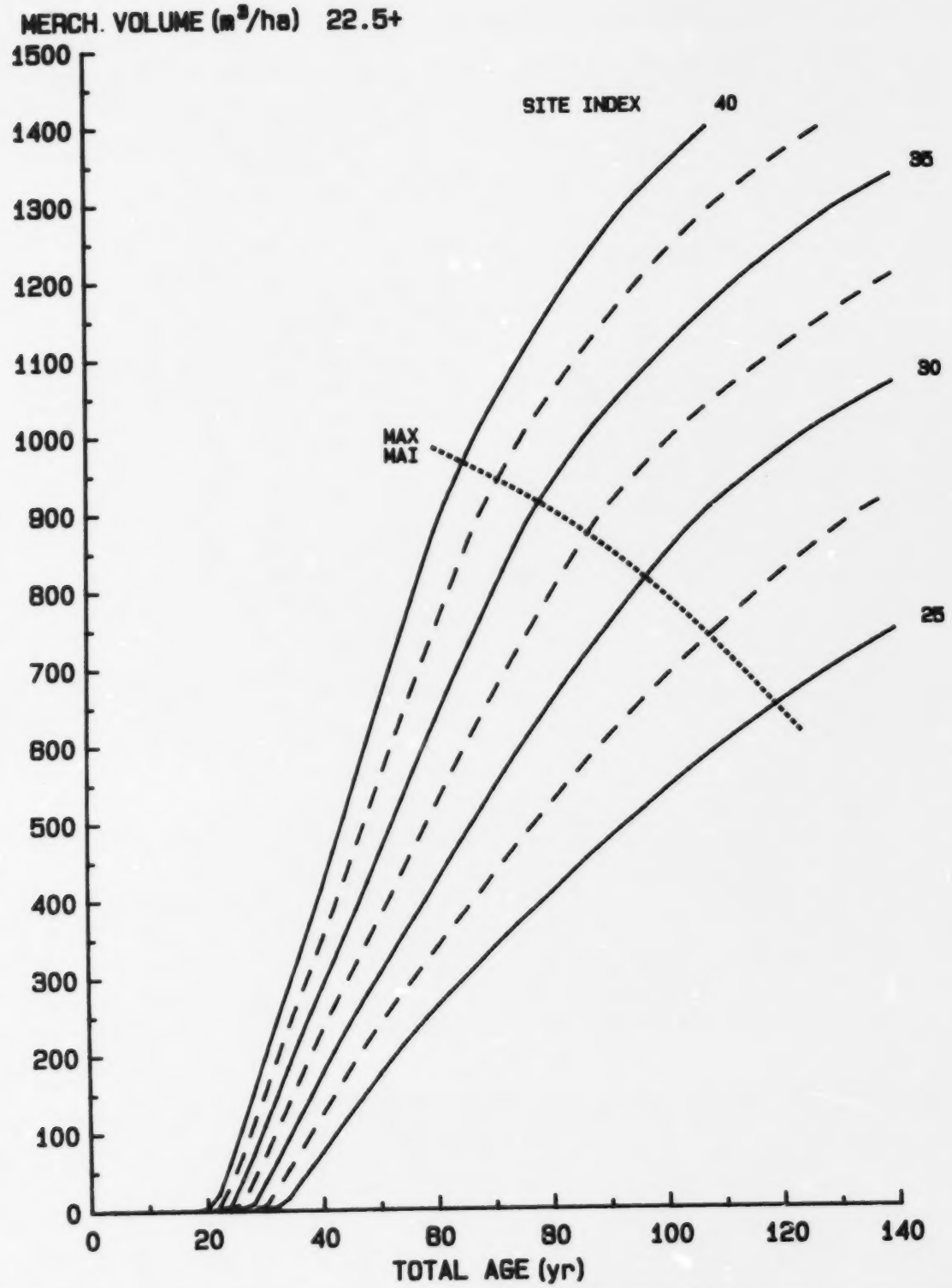

FIGURE A-9. Merchantable volume/age relationship for stands planted with 1110 trees/ha, precommercially thinned to 500.

MANAGED STAND YIELD TABLES — COASTAL DOUGLAS-FIR

TABLE A-11. Stand planted with 750 trees/ha — untreated

A-11.1 Cumulative production

REF. HEIGHT (m)	VOLUME (m^3/ha)								BASAL AREA (m^2/ha)	MEAN DBHg (cm)	STEM COUNT (/ha)	CROWN COVER (%)	250 CROP TREES (12.5+)		
	Gross Prod'n	Total Standing		Merchantable									Merch. Vol. (m^3/ha)	Mean DBHg (cm)	Live Crown (%)
	0.0+	0.0+	7.5+	12.5+	17.5+	22.5+	27.5+	32.5+							
0	0	0	0	0	0	0	0	0	0.0	0.0	750	0	0	0.0	—
3	0	0	0	0	0	0	0	0	0.1	1.2	717	11	0	0.0	—
6	4	4	0	0	0	0	0	0	1.8	5.7	689	42	0	0.0	—
(8)	(U N T R E A T E D)														
9	**16**	**16**	**16**	**1**	**0**	**0**	**0**	**0**	**5.3**	**9.8**	**680**	**77**	**1**	**12.9**	**66**
12	**45**	**45**	**45**	**28**	**7**	**0**	**0**	**0**	**10.8**	**14.2**	**667**	**93**	**17**	**15.8**	**69**
15	86	84	84	68	43	4	0	0	16.4	17.8	662	97	37	19.7	69
18	142	140	140	124	117	44	4	0	22.1	20.6	662	99	64	22.9	59
21	206	204	204	185	183	121	16	0	27.5	23.0	662	100	96	25.6	51
24	**279**	**277**	**277**	**255**	**255**	**216**	**89**	**6**	**32.8**	**25.1**	**662**	**100**	**133**	**28.2**	**45**
27	**366**	**364**	**364**	**339**	**338**	**319**	**212**	**54**	**38.5**	**27.8**	**662**	**100**	**176**	**31.2**	**40**
30	**465**	**463**	**463**	**434**	**434**	**422**	**362**	**195**	**47.1**	**30.1**	**662**	**100**	**225**	**34.1**	**35**
33	581	579	579	547	547	540	503	356	55.4	32.6	662	100	291	37.4	32
36	710	705	705	671	671	666	644	532	63.2	35.2	650	100	364	40.5	29
39	844	830	830	800	800	798	785	706	71.4	37.7	638	100	445	43.5	27
42	**991**	**970**	**970**	**934**	**934**	**932**	**924**	**879**	**78.9**	**40.4**	**600**	**100**	**535**	**46.4**	**25**
45	**1143**	**1070**	**1070**	**1036**	**1036**	**1036**	**1033**	**1030**	**80.0**	**43.2**	**545**	**99**	**632**	**49.1**	**24**
48	**1330**	**1155**	**1155**	**1120**	**1120**	**1120**	**1120**	**1120**	**83.0**	**46.5**	**489**	**98**	**736**	**51.8**	**22**
51	1463	1221	1221	1185	1185	1185	1185	1185	84.7	49.8	435	97	847	54.3	21
54	1623	1291	1291	1256	1256	1256	1256	1256	86.3	53.2	388	95	964	56.8	21
57	1776	1357	1357	1329	1329	1329	1329	1329	87.2	56.4	348	94	1086	59.1	20

A-11.2 Stand and stock tables (2.5+)

REF. HEIGHT (m)	STEM COUNT (/ha)	MERCH. VOL. (m^3/ha)	DIAMETER CLASSES (cm)														
			5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
12	667			173	481	13											
		30		*2*	*21*	*7*											
21	**662**				**20**	**303**	**307**	**32**									
		185			***2***	***82***	***105***	***16***									
30	662					49	136	265	192	20							
		434				*12*	*60*	*167*	*172*	*23*							
39	**638**					**7**	**32**	**111**	**186**	**186**	**131**	**25**					
		800				***2***	***13***	***79***	***172***	***232***	***242***	***60***					
48	489								61	99	136	99	74	20			
		1120							*68*	*165*	*290*	*264*	*255*	*78*			

A-11.3 Maximum mean annual increment (m^3/ha) and culmination age (years: total age)

DBH LIMIT (cm)	SITE INDEX							
	40		35		30		25	
	MAX. MAI	CULM'N AGE	MAX. MAI	CULM'N AGE	MAX. MAI	CULM'N AGE	MAX. MAI	CULM'N AGE
12.5+	**15.4**	**63**	**12.3**	**75**	**8.9**	**93**	**5.8**	**110**
17.5+	**15.4**	**63**	**12.3**	**75**	**8.9**	**93**	**5.8**	**110**
22.5+	**15.2**	**64**	**12.3**	**76**	**8.9**	**93**	**5.7**	**112**
27.5+	**15.2**	**65**	**12.2**	**77**	**8.7**	**94**	**5.8**	**125**
32.5+	**14.3**	**73**	**11.7**	**85**	**8.2**	**104**	**5.0**	**150**

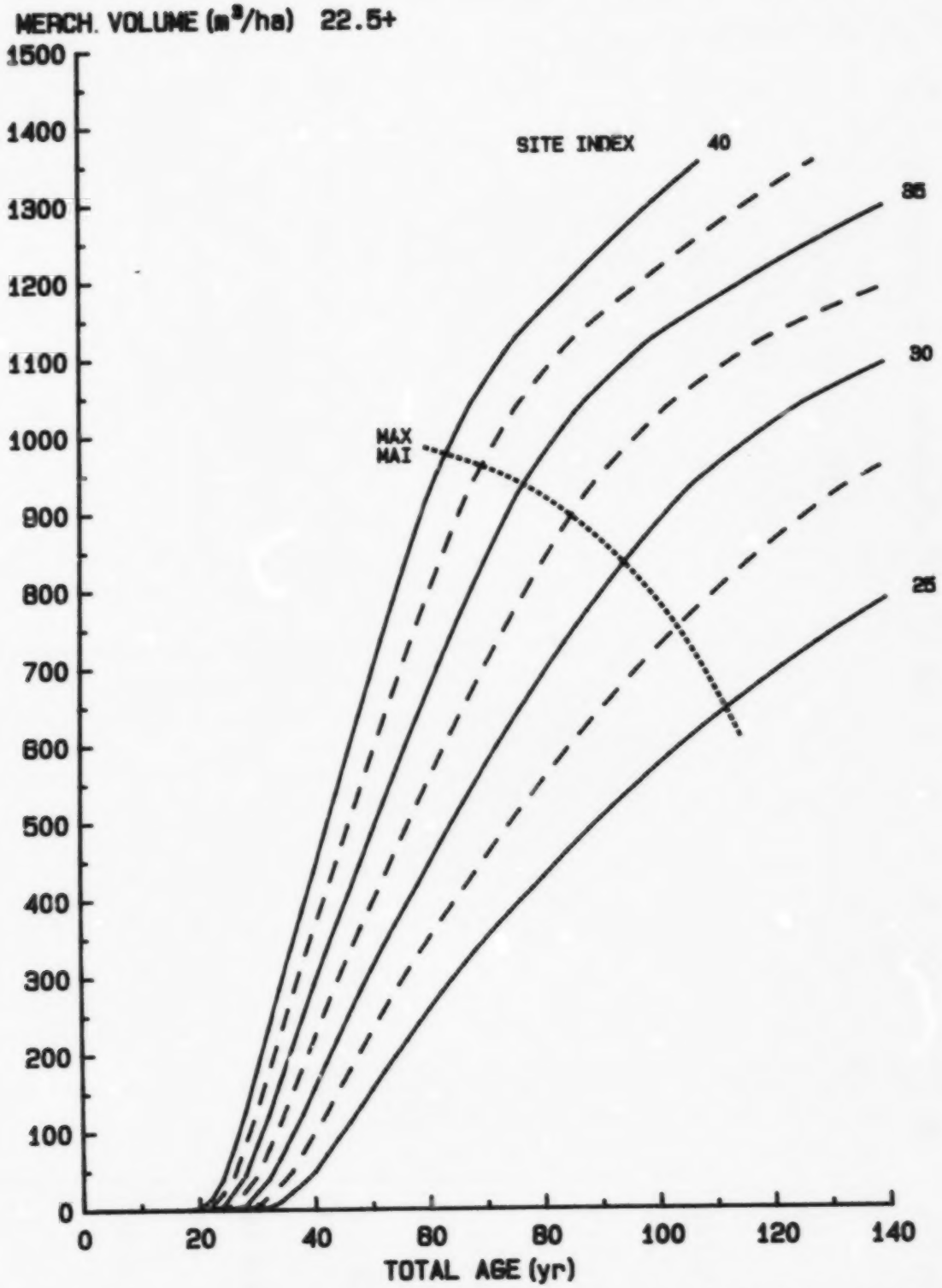

FIGURE A-10. Merchantable volume/age relationship for stands planted with 750 trees/ha, untreated.

MANAGED STAND YIELD TABLES — COASTAL DOUGLAS-FIR

TABLE A-12. Stand planted with 500 trees/ha — untreated

A-12.1 Cumulative production

REF. HEIGHT (m)	VOLUME (m^3/ha)								BASAL AREA (m^2/ha)	MEAN DBHg (cm)	STEM COUNT (/ha)	CROWN COVER (%)	250 CROP TREES (12.5+)		
	Gross Prod'n	Total Standing		Merchantable									Merch. Vol. (m^3/ha)	Mean DBHg (cm)	Live Crown (%)
	0.0+	0.0+	7.5+	12.5+	17.5+	22.5+	27.5+	32.5+							
0	0	0	0	0	0	0	0	0	0.0	0.0	500	0	0	0.0	—
3	0	0	0	0	0	0	0	0	0.0	1.2	477	7	0	0.0	—
6	3	3	0	0	0	0	0	0	1.2	5.7	459	27	0	0.0	—
(6)	(UNTREATED)														
9	**10**	**10**	**10**	**3**	**0**	**0**	**0**	**0**	**3.5**	**9.9**	**445**	**55**	**1**	**13.1**	**67**
12	**32**	**31**	**31**	**20**	**6**	**0**	**0**	**0**	**7.3**	**14.6**	**436**	**79**	**15**	**15.7**	**69**
15	61	60	60	49	38	7	0	0	12.1	18.9	432	90	38	20.0	72
18	106	105	105	94	93	50	8	0	16.8	22.2	432	96	65	23.8	68
21	159	158	158	145	145	130	37	5	21.8	25.1	432	98	101	27.0	59
24	**222**	**221**	**221**	**206**	**206**	**202**	**126**	**28**	**27.0**	**28.2**	**432**	**99**	**143**	**30.0**	**52**
27	**297**	**296**	**296**	**283**	**283**	**283**	**239**	**129**	**33.0**	**31.2**	**432**	**100**	**193**	**33.6**	**46**
30	**383**	**382**	**382**	**361**	**361**	**361**	**353**	**268**	**39.9**	**34.3**	**432**	**100**	**249**	**36.8**	**41**
33	485	484	484	460	460	460	457	407	47.2	37.3	432	100	322	40.4	37
36	598	597	597	570	570	570	570	549	55.4	40.4	432	100	401	43.7	34
39	715	714	714	684	684	684	684	672	62.5	43.2	427	100	488	46.8	31
42	**845**	**844**	**844**	**812**	**812**	**812**	**812**	**803**	**69.0**	**46.0**	**415**	**100**	**583**	**49.8**	**29**
45	**983**	**969**	**969**	**924**	**924**	**924**	**924**	**921**	**73.9**	**48.8**	**395**	**99**	**684**	**52.6**	**26**
48	**1125**	**1067**	**1067**	**1029**	**1029**	**1029**	**1029**	**1029**	**78.4**	**51.6**	**375**	**99**	**791**	**55.3**	**25**
51	1264	1169	1169	1134	1134	1134	1134	1134	82.4	54.4	355	98	905	57.8	23
54	1408	1271	1271	1235	1235	1235	1235	1235	86.3	57.2	336	97	1022	60.2	22
57	1551	1357	1357	1329	1329	1329	1329	1329	90.0	59.9	319	96	1143	62.5	21

A-12.2 Stand and stock tables (2.5+)

REF. HEIGHT (m)	STEM COUNT (/ha)	MERCH. VOL. (m^3/ha)	DIAMETER CLASSES (cm)													
			5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
12	436			78	338	20											
		21		*1*	*14*	*6*											
21	**432**					**69**	**294**	**62**	**7**								
		145				***15***	***83***	***32***	***5***								
30	432						20	137	194	69	12						
		361					*8*	*85*	*168*	*81*	*19*						
39	**427**							**20**	**81**	**120**	**118**	**58**	**25**	**7**			
		684						***12***	***81***	***168***	***212***	***120***	***70***	***21***			
48	375								2	32	89	105	82	32	24	7	2
		1029							*2*	*48*	*180*	*265*	*254*	*119*	*112*	*36*	*13*

A-12.3 Maximum mean annual increment (m^3/ha) and culmination age (years: total age)

DBH LIMIT (cm)	SITE INDEX							
	40		35		30		25	
	MAX. MAI	CULM'N AGE	MAX. MAI	CULM'N AGE	MAX. MAI	CULM'N AGE	MAX. MAI	CULM'N AGE
12.5+	13.6	70	10.7	82	7.6	100	4.9	115
17.5+	**13.6**	**70**	**10.7**	**82**	**7.6**	**100**	**4.9**	**115**
22.5+	13.6	70	10.7	82	7.6	100	4.9	115
27.5+	**13.6**	**70**	**10.7**	**82**	**7.6**	**100**	**4.9**	**115**
32.5+	13.5	71	10.6	83	7.5	102	4.8	126

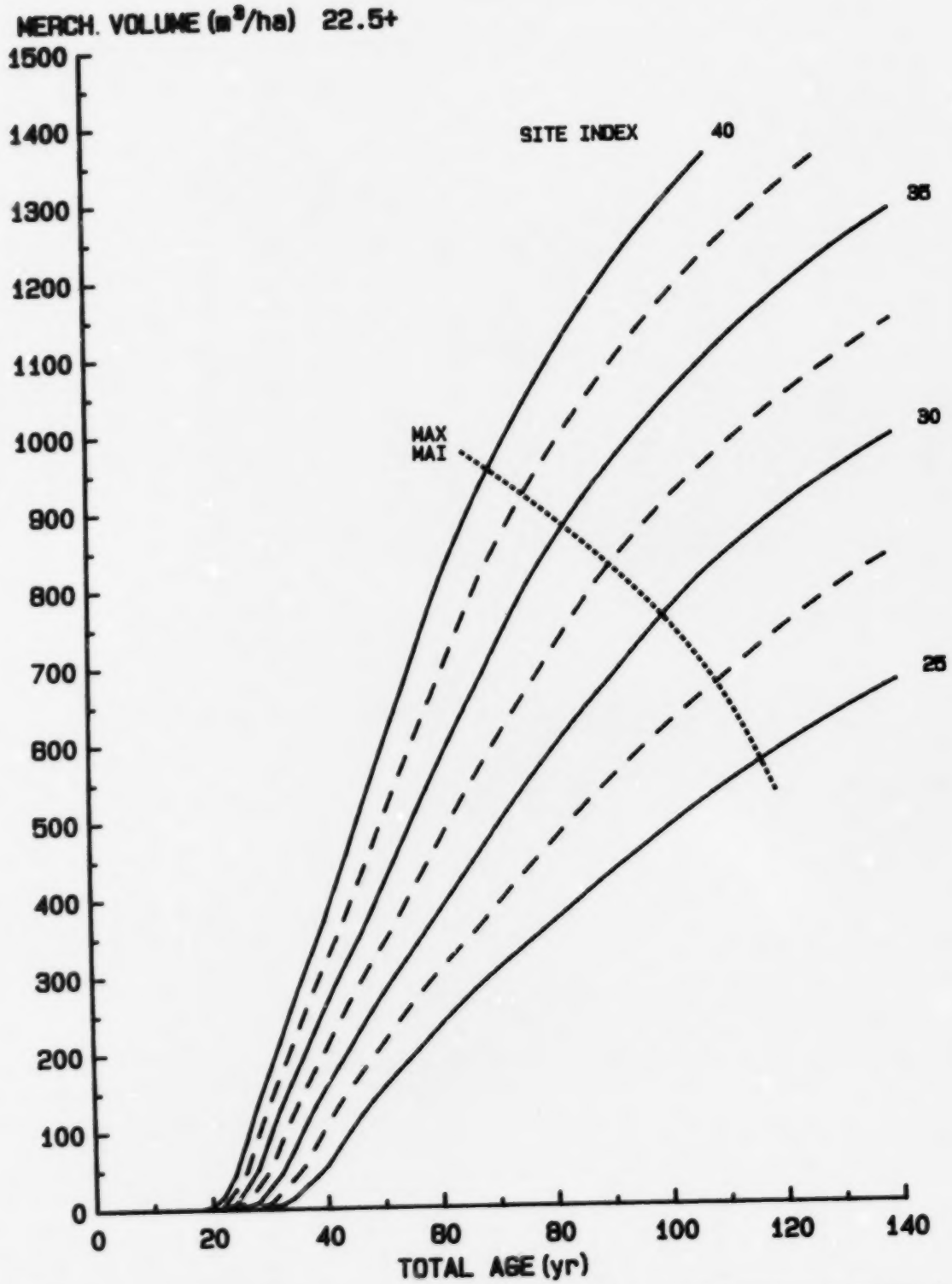

FIGURE A-11. Merchantable volume/age relationship for stands planted with 500 trees/ha, untreated.

MANAGED STAND YIELD TABLES — COASTAL DOUGLAS-FIR

TABLE A-13. Stand planted with 300 trees/ha — untreated

A-13.1 Cumulative production

REF. HEIGHT (m)	VOLUME (m³/ha)								BASAL AREA (m²/ha)	MEAN DBHg (cm)	STEM COUNT (/ha)	CROWN COVER (%)	250 CROP TREES (12.5+)		
	Gross Prod'n	Total Standing		Merchantable									Merch. Vol. (m³/ha)	Mean DBHg (cm)	Live Crown (%)
	0.0+	0.0+	7.5+	12.5+	17.5+	22.5+	27.5+	32.5+							
0	0	0	0	0	0	0	0	0	0.0	0.0	300	0	0	0.0	—
3	0	0	0	0	0	0	0	0	0.0	1.2	288	5	0	0.0	—
6	2	2	0	0	0	0	0	0	0.6	5.7	277	17	0	0.0	—
(6)	⟨ UNTREATED ⟩														
9	**7**	**7**	**7**	**1**	**0**	**0**	**0**	**0**	**2.1**	**10.2**	**269**	**34**	**1**	**12.5**	**66**
12	**19**	**18**	**18**	**12**	**1**	**0**	**0**	**0**	**4.6**	**14.9**	**264**	**53**	**12**	**15.3**	**68**
15	39	38	38	32	28	4	0	0	7.9	19.6	264	73	32	19.7	71
18	70	69	69	62	62	49	7	0	11.8	24.0	264	84	60	24.0	73
21	110	109	109	100	100	98	57	11	15.8	27.7	264	90	98	27.8	71
24	**159**	**158**	**158**	**148**	**148**	**148**	**137**	**55**	**20.2**	**31.4**	**264**	**93**	**145**	**31.4**	**64**
27	**218**	**217**	**217**	**205**	**205**	**205**	**205**	**164**	**25.0**	**35.2**	**264**	**95**	**200**	**35.5**	**57**
30	**287**	**286**	**286**	**271**	**271**	**271**	**271**	**260**	**31.5**	**39.0**	**264**	**97**	**261**	**39.2**	**51**
33	367	366	366	349	349	349	349	349	38.3	42.7	264	98	340	43.2	46
36	457	456	456	435	435	435	435	435	44.8	46.4	264	98	423	46.8	42
39	552	551	551	530	530	530	530	530	51.3	49.9	264	99	515	50.1	38
42	**654**	**653**	**653**	**630**	**630**	**630**	**630**	**630**	**58.0**	**53.0**	**264**	**99**	**613**	**53.3**	**35**
45	**762**	**761**	**761**	**738**	**738**	**738**	**738**	**738**	**64.3**	**55.8**	**264**	**100**	**717**	**56.2**	**33**
48	**877**	**876**	**876**	**847**	**847**	**847**	**847**	**847**	**70.8**	**58.4**	**264**	**100**	**827**	**59.0**	**30**
51	995	994	994	964	964	964	964	964	77.1	60.9	264	100	941	61.6	28
54	1118	1109	1109	1074	1074	1074	1074	1074	82.4	63.7	258	100	1059	64.0	27
57	1240	1212	1212	1180	1180	1180	1180	1180	86.8	66.3	252	99	1178	66.3	25

A-13.2 Stand and stock tables (2.5+)

REF. HEIGHT (m)	STEM COUNT (/ha)	MERCH. VOL. (m³/ha)	DIAMETER CLASSES (cm)													
			5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
12	264			49	203	12											
		13		*1*	*11*	*1*											
21	**264**					**12**	**129**	**106**	**17**								
		100				***2***	***41***	***48***	***11***								
30	264							17	80	105	62						
		271						*11*	*66*	*109*	*85*						
39	**264**								**5**	**25**	**80**	**75**	**67**	**12**			
		530							***5***	***31***	***130***	***153***	***173***	***38***			
48	264									5	18	26	68	81	55	6	5
		847								*7*	*34*	*52*	*188*	*270*	*236*	*31*	*29*

A-13.3. Maximum mean annual increment (m³/ha) and culmination age (years: total age)

DBH LIMIT (cm)	SITE INDEX							
	40		35		30		25	
	MAX. MAI	CULM'N AGE	MAX. MAI	CULM'N AGE	MAX. MAI	CULM'N AGE	MAX. MAI	CULM'N AGE
12.5+	11.5	89	8.6	100	5.9	110	3.8	118
17.5+	**11.5**	**89**	**8.6**	**100**	**5.9**	**110**	**3.8**	**118**
22.5+	11.5	89	8.6	100	5.9	110	3.8	118
27.5+	**11.5**	**89**	**8.6**	**100**	**5.9**	**110**	**3.8**	**118**
32.5+	11.5	89	8.6	100	5.9	110	3.8	118

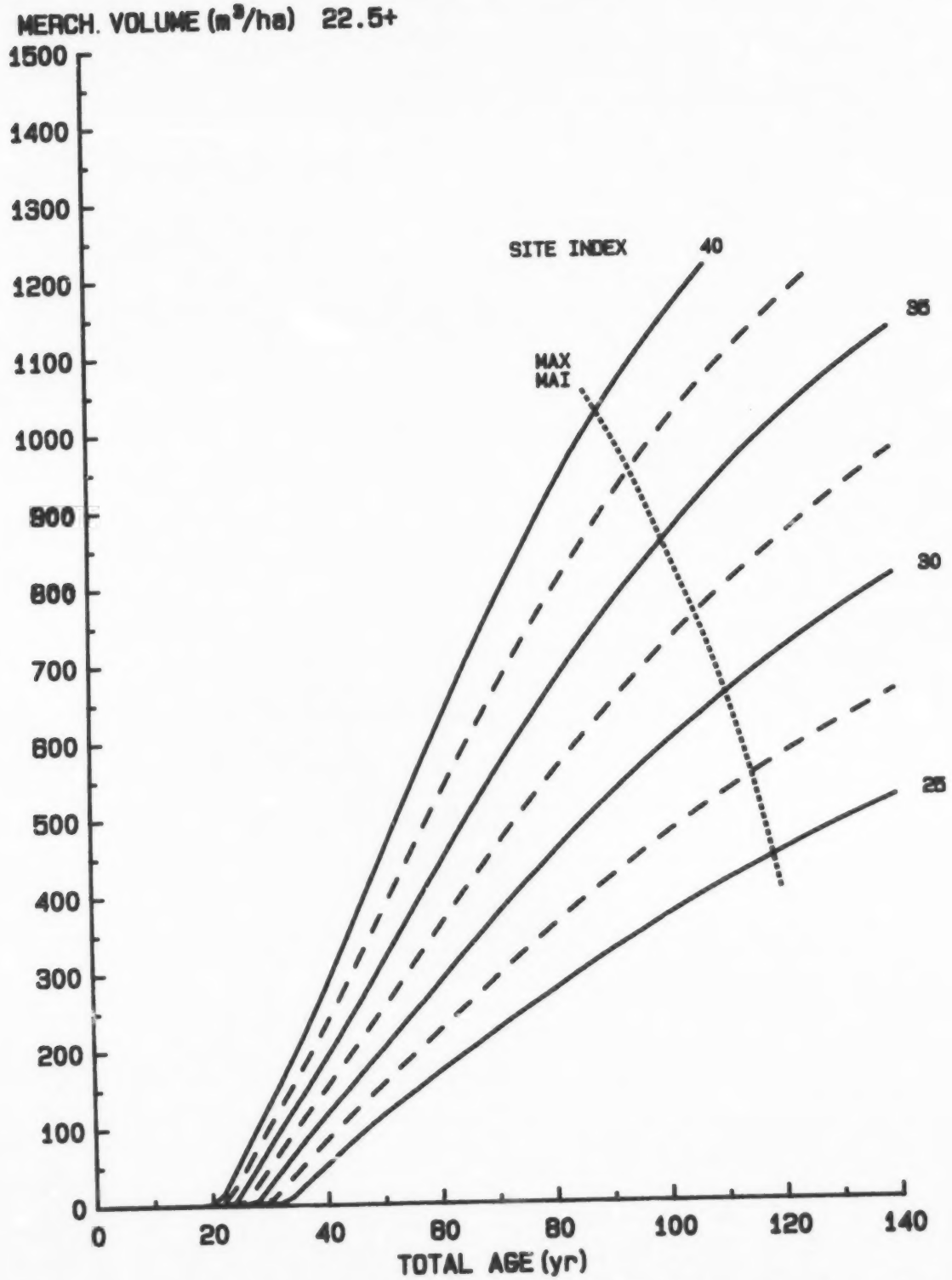

FIGURE A-12. Merchantable volume/age relationship for stands planted with 300 trees/ha, untreated.

MANAGED STAND YIELD TABLES — COASTAL DOUGLAS-FIR

TABLE A-14. Reference height, top height, and mean height by treatment regime

Reference Height	REGIME																			
	4440		4440–1110		4440–500		2500		2500–1110		2500–500		1110		1110–500		750		500		300	
	HEIGHT (m)																					
	Top	Mean	Top	Mean	Top	Mean	Top	Mean	Top	Mean	Top	Mean	Top	Mean	Top	Mean	Top	Mean	Top	Mean	Top	Mean
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	3.0	2.4	3.0	2.4	3.0	2.4	3.0	2.4	3.0	2.4	3.0	2.4	2.9	2.4	2.9	2.4	2.8	2.4	2.7	2.4	2.6	2.4
6	6.0	4.9	6.0	4.9	6.0	4.9	5.9	4.9	5.9	4.9	5.9	4.9	5.7	4.9	5.7	4.9	5.6	4.9	5.4	4.9	5.2	4.9
(6)	(6.0	4.9	6.0	5.2	5.9	5.2	5.9	4.9	5.8	5.5	5.7	5.5	5.7	4.9	5.6	5.2	5.6	4.9	5.4	4.9	5.2	4.9)
9	9.0	6.7	9.0	7.9	8.8	8.2	8.9	7.3	8.5	7.8	8.7	8.2	8.6	7.3	8.5	7.8	8.4	7.3	8.2	7.3	7.8	7.3
12	12.0	8.5	12.0	10.6	11.7	11.6	11.8	9.7	11.7	10.1	11.6	11.1	11.4	9.7	11.3	10.4	11.2	9.7	10.9	9.7	10.4	9.7
15	15.0	9.8	15.0	13.1	14.7	13.7	14.8	11.9	14.6	12.9	14.5	13.9	14.3	12.1	14.2	13.0	14.0	12.1	13.6	12.1	13.0	12.1
18	18.0	11.3	18.0	15.6	17.6	16.5	17.7	13.7	17.6	15.5	17.5	16.8	17.1	14.5	17.0	15.5	16.8	14.5	16.3	14.5	15.6	14.5
21	21.0	14.3	21.0	18.0	20.5	19.2	20.7	15.5	20.5	18.0	20.4	19.5	20.0	16.8	19.9	18.0	19.6	16.9	19.0	16.9	18.2	17.0
24	24.0	17.4	24.0	20.4	23.4	21.8	23.8	17.4	23.4	20.5	23.3	22.0	22.8	19.0	22.7	20.5	22.4	19.3	21.8	19.3	20.8	19.4
27	27.0	21.0	27.0	22.9	26.4	24.4	26.8	19.8	26.4	22.9	26.2	24.7	25.7	21.4	25.6	23.2	25.2	21.7	24.5	21.9	23.4	21.8
30	30.0	24.5	30.0	25.8	29.3	27.4	29.8	23.0	29.3	25.5	29.1	27.6	28.8	24.0	28.5	25.9	28.0	24.2	27.2	24.4	26.0	24.2
33	33.0	28.0	33.0	28.9	32.2	30.4	32.5	27.5	32.2	28.1	32.0	30.5	31.5	26.6	31.3	28.4	30.8	26.8	29.9	26.8	28.6	26.7
36	36.0	31.6	36.0	32.0	35.2	33.2	35.5	30.9	35.1	31.1	34.9	33.2	34.4	29.3	34.2	31.0	33.6	29.3	32.7	29.4	31.2	29.2
39	39.0	35.0	39.0	35.0	38.1	36.0	38.4	34.1	38.1	34.2	37.8	36.0	37.2	32.2	37.0	33.5	36.4	31.7	35.4	31.9	33.8	31.7
42	42.0	38.2	42.0	38.1	41.0	38.7	41.4	37.3	41.0	37.5	40.7	38.8	40.1	35.4	39.9	36.0	39.2	34.3	38.1	34.4	36.4	34.1
45	45.0	41.5	45.0	41.2	44.0	41.5	44.3	40.7	43.9	40.8	43.6	41.6	42.9	38.4	42.7	39.0	42.0	37.2	40.8	37.3	39.0	36.6
48	48.0	45.0	48.0	45.3	46.9	44.9	47.3	44.2	46.9	44.2	46.5	44.5	45.8	41.3	45.6	42.4	44.8	40.4	43.5	40.2	41.6	39.1
51	51.0	48.4	51.0	48.4	49.8	48.2	50.2	47.5	49.8	47.2	49.4	47.5	48.6	45.1	48.4	45.7	47.6	43.6	46.3	43.0	44.2	41.5
54	54.0	51.7	54.0	51.5	52.8	51.5	53.2	50.6	52.7	50.3	52.3	50.5	51.5	48.5	51.3	48.8	50.4	46.9	49.0	45.7	46.8	44.0
57	57.0	54.9	57.0	54.6	55.7	54.7	56.2	53.3	55.7	53.3	55.3	53.3	54.4	51.2	54.1	51.8	53.2	50.3	51.7	48.4	49.4	46.6

MANAGED STAND YIELD TABLES — COASTAL DOUGLAS-FIR

TABLE A-15. Summary of total standing volume (0.0+) and DBH by age, site class, and treatment regime

I. SITE 40 (Good)

Breast-Height Age	4440 Vol.	4440 DBH	4440–1110 Vol.	4440–1110 DBH	4440–500 Vol.	4440–500 DBH	2500 Vol.	2500 DBH	2500–1110 Vol.	2500–1110 DBH	2500–500 Vol.	2500–500 DBH	1110 Vol.	1110 DBH	1110–500 Vol.	1110–500 DBH	750 Vol.	750 DBH	500 Vol.	500 DBH	300 Vol.	300 DBH
10	78	7.4	49	11.1	28	12.8	69	9.8	50	11.4	29	13.1	41	11.4	25	12.9	30	12.0	20	12.2	12	12.5
20	306	13.1	253	19.3	185	21.3	293	15.0	252	19.5	185	24.5	221	19.9	165	24.3	183	22.2	140	24.1	96	26.5
30	517	21.5	486	24.8	391	31.5	507	20.7	491	24.6	394	31.7	452	25.1	363	31.9	397	28.4	324	32.2	240	36.5
40	**719**	**29.0**	**731**	**30.9**	**634**	**37.7**	**705**	**28.2**	**733**	**30.0**	**643**	**37.9**	**699**	**30.3**	**600**	**38.3**	**644**	**33.9**	**542**	**38.9**	**413**	**44.6**
50	**921**	**35.1**	**942**	**36.6**	**883**	**43.0**	**899**	**34.4**	**926**	**35.5**	**898**	**42.7**	**892**	**35.6**	**835**	**43.2**	**866**	**38.6**	**757**	**44.1**	**585**	**50.9**
60	**1091**	**40.3**	**1111**	**41.8**	**1107**	**47.7**	**1045**	**39.6**	**1073**	**40.6**	**1128**	**46.8**	**1031**	**40.8**	**1021**	**47.6**	**1023**	**42.8**	**952**	**48.4**	**746**	**55.4**
70	1227	44.8	1243	45.9	1257	51.9	1169	44.2	1189	45.2	1281	50.4	1140	45.4	1148	51.8	1152	47.1	1085	52.1	897	58.8
80	1327	48.5	1350	49.5	1372	55.5	1263	48.0	1277	49.0	1408	53.5	1224	49.2	1252	55.2	1243	50.9	1201	55.3	1030	61.8
90	1407	51.5	1426	52.5	1463	58.6	1338	51.1	1348	52.0	1504	56.2	1294	52.0	1350	58.1	1311	54.2	1297	58.0	1140	64.5

II. SITE 35 (Good-Medium)

Breast-Height Age	4440 Vol.	4440 DBH	4440–1110 Vol.	4440–1110 DBH	4440–500 Vol.	4440–500 DBH	2500 Vol.	2500 DBH	2500–1110 Vol.	2500–1110 DBH	2500–500 Vol.	2500–500 DBH	1110 Vol.	1110 DBH	1110–500 Vol.	1110–500 DBH	750 Vol.	750 DBH	500 Vol.	500 DBH	300 Vol.	300 DBH
10	56	6.7	32	9.8	18	10.9	49	8.9	33	10.1	19	11.4	27	10.3	16	11.2	20	10.3	13	10.5	8	10.8
20	246	11.2	194	18.0	136	22.3	232	14.1	194	18.1	135	22.3	166	18.3	119	22.1	134	20.3	100	21.9	66	23.5
30	426	17.7	381	22.3	295	28.3	417	17.5	381	22.2	296	28.5	344	22.7	269	28.5	296	25.6	237	28.8	171	32.2
40	**586**	**24.2**	**566**	**26.7**	**467**	**33.8**	**569**	**23.4**	**574**	**26.4**	**470**	**34.0**	**535**	**26.9**	**437**	**34.1**	**475**	**30.4**	**393**	**34.6**	**294**	**39.4**
50	**735**	**29.5**	**749**	**31.3**	**653**	**38.1**	**721**	**28.7**	**751**	**30.4**	**653**	**38.3**	**717**	**30.7**	**618**	**38.7**	**663**	**34.3**	**559**	**39.4**	**426**	**45.2**
60	**881**	**33.9**	**905**	**35.4**	**830**	**41.9**	**863**	**33.2**	**893**	**34.3**	**842**	**41.7**	**857**	**34.4**	**785**	**42.2**	**827**	**37.6**	**711**	**43.1**	**549**	**49.8**
70	1004	37.6	1021	39.0	995	45.3	974	36.9	1001	38.0	1015	44.6	963	38.2	937	45.3	947	40.6	855	46.2	662	53.2
80	1111	41.0	1131	42.1	1132	48.2	1061	40.3	1089	41.2	1153	47.3	1047	41.5	1040	48.1	1040	43.3	973	48.9	766	55.9
90	1198	43.8	1213	44.9	1225	50.9	1142	43.2	1165	44.2	1246	49.6	1117	44.4	1121	50.9	1125	46.1	1055	51.3	862	58.1
100	**1266**	**46.3**	**1287**	**47.3**	**1302**	**53.3**	**1206**	**45.7**	**1223**	**46.7**	**1333**	**51.6**	**1173**	**47.0**	**1186**	**53.1**	**1189**	**48.5**	**1130**	**53.3**	**949**	**59.9**
110	**1323**	**48.4**	**1347**	**49.3**	**1368**	**55.4**	**1259**	**47.9**	**1273**	**48.9**	**1404**	**53.4**	**1221**	**49.0**	**1248**	**55.0**	**1240**	**50.7**	**1196**	**55.1**	**1025**	**61.6**
120	**1373**	**50.2**	**1393**	**51.1**	**1425**	**57.2**	**1204**	**49.6**	**1318**	**50.7**	**1459**	**55.0**	**1263**	**50.7**	**1310**	**56.8**	**1281**	**52.7**	**1256**	**56.8**	**1092**	**63.3**

III. SITE 30 (Medium)

Breast-Height Age	4440 Vol.	4440 DBH	4440–1110 Vol.	4440–1110 DBH	4440–500 Vol.	4440–500 DBH	2500 Vol.	2500 DBH	2500–1110 Vol.	2500–1110 DBH	2500–500 Vol.	2500–500 DBH	1110 Vol.	1110 DBH	1110–500 Vol.	1110–500 DBH	750 Vol.	750 DBH	500 Vol.	500 DBH	300 Vol.	300 DBH
10	41	5.9	22	8.3	12	9.2	35	7.8	23	8.7	12	9.7	18	8.9	11	9.6	13	8.8	8	8.9	6	9.1
20	183	10.1	137	16.2	90	19.7	170	13.1	137	16.3	91	19.7	117	16.4	79	19.4	91	18.1	65	19.3	42	20.1
30	339	14.3	286	20.1	212	25.3	327	15.5	284	20.2	213	25.6	252	20.7	191	25.4	210	23.2	163	25.4	113	28.0
40	**483**	**19.3**	**424**	**23.3**	**334**	**29.6**	**456**	**18.8**	**426**	**23.2**	**336**	**29.8**	**388**	**23.7**	**308**	**30.0**	**337**	**26.8**	**272**	**30.3**	**198**	**34.0**
50	**577**	**23.9**	**553**	**26.4**	**455**	**33.5**	**559**	**23.0**	**562**	**26.2**	**458**	**33.7**	**523**	**26.6**	**425**	**33.8**	**463**	**30.1**	**382**	**34.3**	**286**	**39.0**
60	**675**	**27.5**	**683**	**29.6**	**579**	**36.5**	**659**	**26.7**	**683**	**28.7**	**587**	**36.8**	**649**	**29.3**	**548**	**37.2**	**591**	**32.9**	**495**	**37.6**	**375**	**43.1**
70	773	30.7	790	32.4	700	39.2	760	30.0	794	31.5	711	39.2	759	31.7	662	39.7	708	35.3	600	40.5	458	46.5
80	864	33.4	887	34.9	810	41.5	847	32.7	877	33.9	821	41.3	842	34.0	765	41.8	808	37.3	693	42.7	534	49.3
90	941	35.7	961	37.1	910	43.5	917	35.0	946	36.1	926	43.1	909	36.2	860	43.7	886	39.1	781	44.6	603	51.5
100	**1008**	**37.7**	**1025**	**39.1**	**1000**	**45.4**	**977**	**37.0**	**1004**	**38.1**	**1020**	**44.7**	**966**	**38.3**	**941**	**45.4**	**951**	**40.7**	**859**	**46.3**	**666**	**53.3**
110	**1068**	**39.6**	**1088**	**40.9**	**1078**	**47.0**	**1026**	**38.9**	**1054**	**39.9**	**1098**	**46.2**	**1013**	**40.1**	**999**	**47.0**	**1003**	**42.2**	**927**	**47.8**	**724**	**54.8**
120	**1121**	**41.3**	**1141**	**42.5**	**1143**	**48.5**	**1071**	**40.6**	**1098**	**41.5**	**1164**	**47.6**	**1055**	**41.8**	**1050**	**48.5**	**1050**	**43.7**	**983**	**49.2**	**777**	**56.2**
130	1166	42.7	1183	43.9	1191	49.9	1112	42.1	1137	43.1	1212	48.7	1091	43.3	1091	49.9	1094	45.1	1025	50.4	827	57.3
140	1207	44.1	1221	45.2	1235	51.2	1150	43.5	1173	44.5	1256	49.8	1124	44.7	1129	51.2	1133	46.4	1063	51.5	872	58.3
150	1240	45.3	1257	46.3	1272	52.3	1181	44.7	1200	45.7	1298	50.8	1151	45.9	1160	52.2	1164	47.5	1099	52.5	913	59.2

IV. SITE 25 (Medium-Poor)

Breast-Height Age	4440 Vol.	4440 DBH	4440–1110 Vol.	4440–1110 DBH	4440–500 Vol.	4440–500 DBH	2500 Vol.	2500 DBH	2500–1110 Vol.	2500–1110 DBH	2500–500 Vol.	2500–500 DBH	1110 Vol.	1110 DBH	1110–500 Vol.	1110–500 DBH	750 Vol.	750 DBH	500 Vol.	500 DBH	300 Vol.	300 DBH
10	29	5.0	15	6.8	8	7.4	24	6.5	16	7.3	8	7.9	12	7.3	7	7.9	9	7.3	6	7.3	4	7.4
20	130	8.9	91	14.0	56	16.7	116	11.6	91	14.1	57	16.7	76	14.0	49	16.4	58	15.4	41	16.0	25	16.5
30	250	11.3	198	18.1	139	22.4	236	14.1	198	18.2	138	22.4	169	18.4	121	22.2	137	20.4	103	22.0	67	23.8
40	**352**	**14.8**	**300**	**20.4**	**224**	**25.8**	**341**	**15.8**	**299**	**20.5**	**225**	**26.0**	**265**	**21.0**	**202**	**25.9**	**223**	**23.5**	**174**	**25.9**	**122**	**28.6**
50	**435**	**18.1**	**392**	**22.5**	**305**	**28.6**	**427**	**17.8**	**393**	**22.5**	**306**	**28.8**	**355**	**23.0**	**279**	**28.9**	**306**	**25.9**	**246**	**29.2**	**178**	**32.7**
60	**509**	**21.1**	**476**	**24.6**	**382**	**31.2**	**499**	**20.4**	**480**	**24.4**	**384**	**31.4**	**441**	**24.8**	**354**	**31.6**	**387**	**28.2**	**316**	**31.9**	**233**	**36.1**
70	576	23.9	552	26.4	454	33.5	558	23.0	561	26.2	457	33.7	522	26.6	424	33.8	462	30.1	381	34.3	285	39.0
80	633	26.0	629	28.3	526	35.2	617	25.2	632	27.6	532	35.6	597	28.1	496	35.8	537	31.7	447	36.2	337	41.4
90	686	27.9	695	29.9	593	36.8	671	27.1	696	29.0	601	37.1	662	29.5	561	37.4	605	33.1	507	37.9	384	43.5
100	**738**	**29.6**	**752**	**31.4**	**657**	**38.2**	**724**	**28.8**	**755**	**30.5**	**667**	**38.3**	**720**	**30.8**	**622**	**38.8**	**667**	**34.4**	**563**	**39.5**	**429**	**45.3**
110	**785**	**31.1**	**803**	**33.7**	**716**	**39.5**	**772**	**30.4**	**805**	**31.8**	**726**	**39.5**	**770**	**32.0**	**676**	**40.0**	**722**	**35.5**	**613**	**40.8**	**469**	**46.9**
120	**830**	**32.4**	**851**	**34.0**	**769**	**40.6**	**814**	**31.7**	**846**	**33.0**	**780**	**40.5**	**811**	**33.1**	**727**	**41.0**	**771**	**36.5**	**658**	**41.9**	**506**	**48.2**
130	870	33.6	893	35.1	817	41.6	852	32.9	883	34.0	829	41.5	847	34.1	772	42.0	814	37.4	699	42.8	539	49.5
140	905	34.6	928	36.1	862	42.6	885	33.9	915	35.0	876	42.3	878	35.1	815	42.8	851	38.2	739	43.7	570	50.5
150	937	35.6	957	37.0	905	43.4	914	34.9	942	36.0	921	43.0	905	36.1	855	43.6	882	39.0	776	44.5	600	51.4
160	**965**	**36.4**	**984**	**37.9**	**944**	**44.2**	**940**	**35.7**	**968**	**36.8**	**961**	**43.7**	**930**	**37.0**	**892**	**44.3**	**911**	**39.7**	**810**	**45.3**	**626**	**52.2**
170	**992**	**37.2**	**1009**	**38.6**	**979**	**44.9**	**964**	**36.5**	**991**	**37.6**	**999**	**44.3**	**953**	**37.8**	**925**	**44.9**	**937**	**40.3**	**841**	**45.9**	**651**	**52.9**
180	**1017**	**38.0**	**1034**	**39.4**	**1011**	**45.6**	**984**	**37.3**	**1012**	**38.4**	**1031**	**45.0**	**973**	**38.6**	**950**	**45.6**	**959**	**41.0**	**869**	**46.6**	**675**	**53.6**

(Fd 1985)

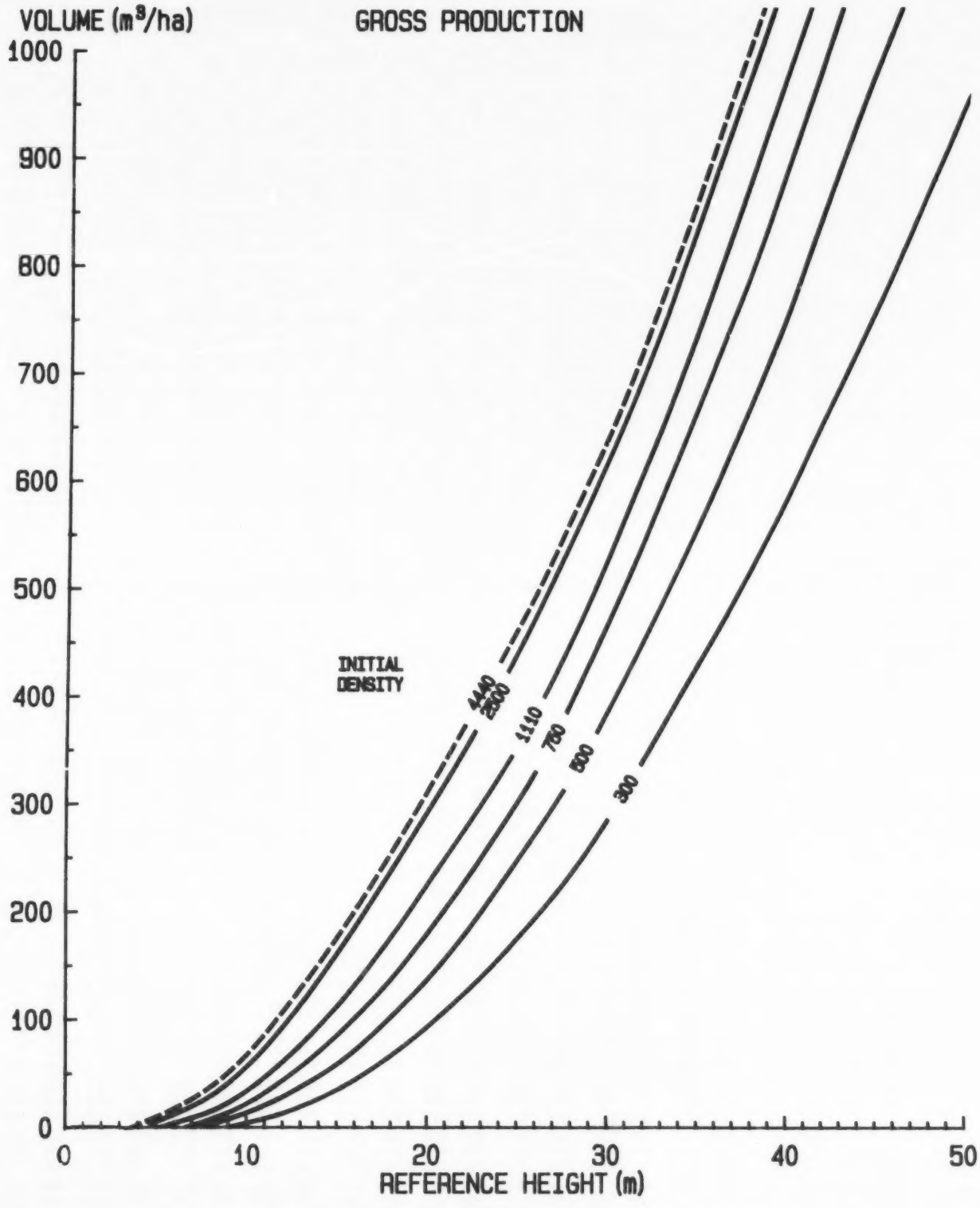

FIGURE A-13. Gross production in relation to height and initial density.

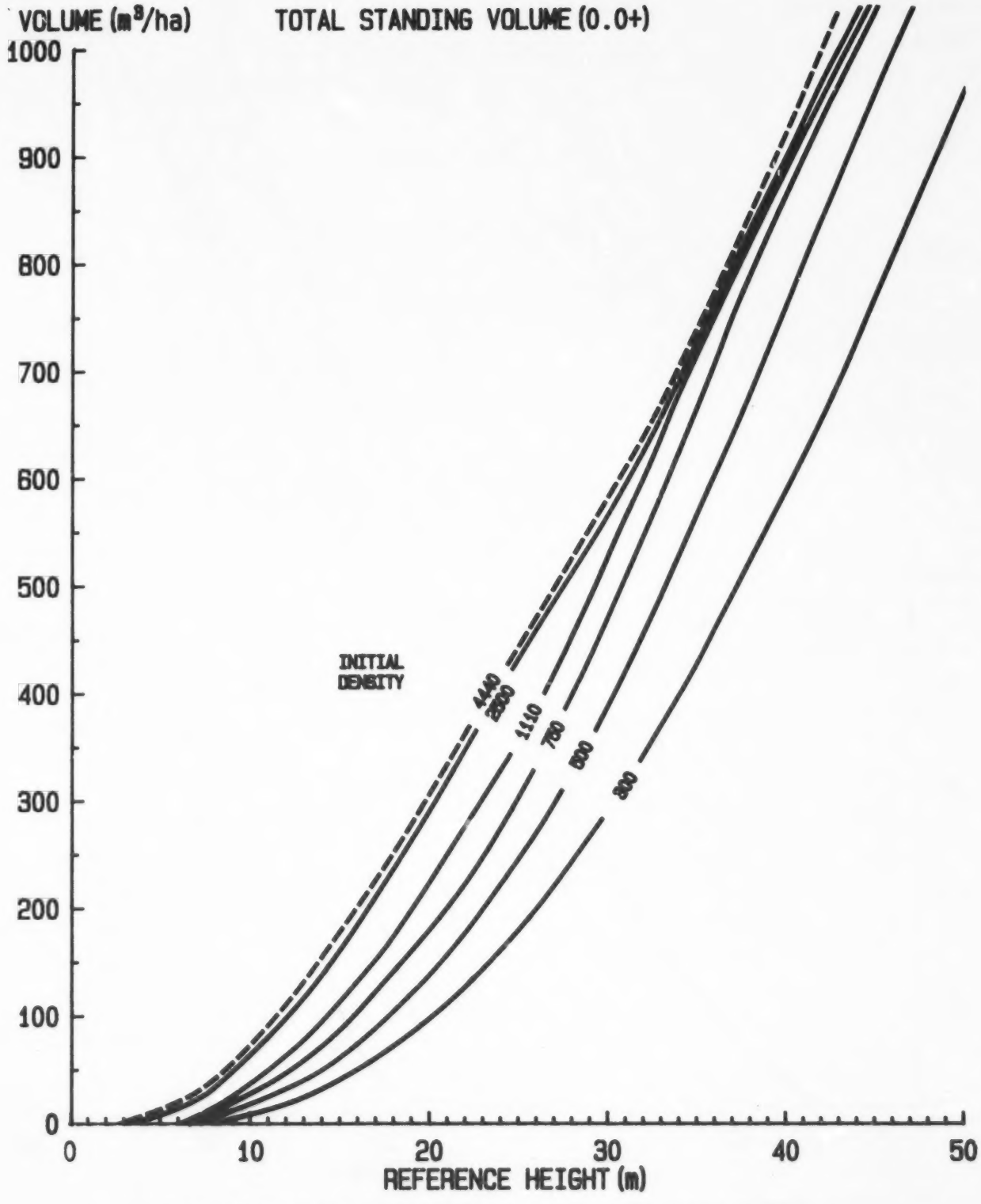

FIGURE A-14. Total standing volume in relation to height and initial density.

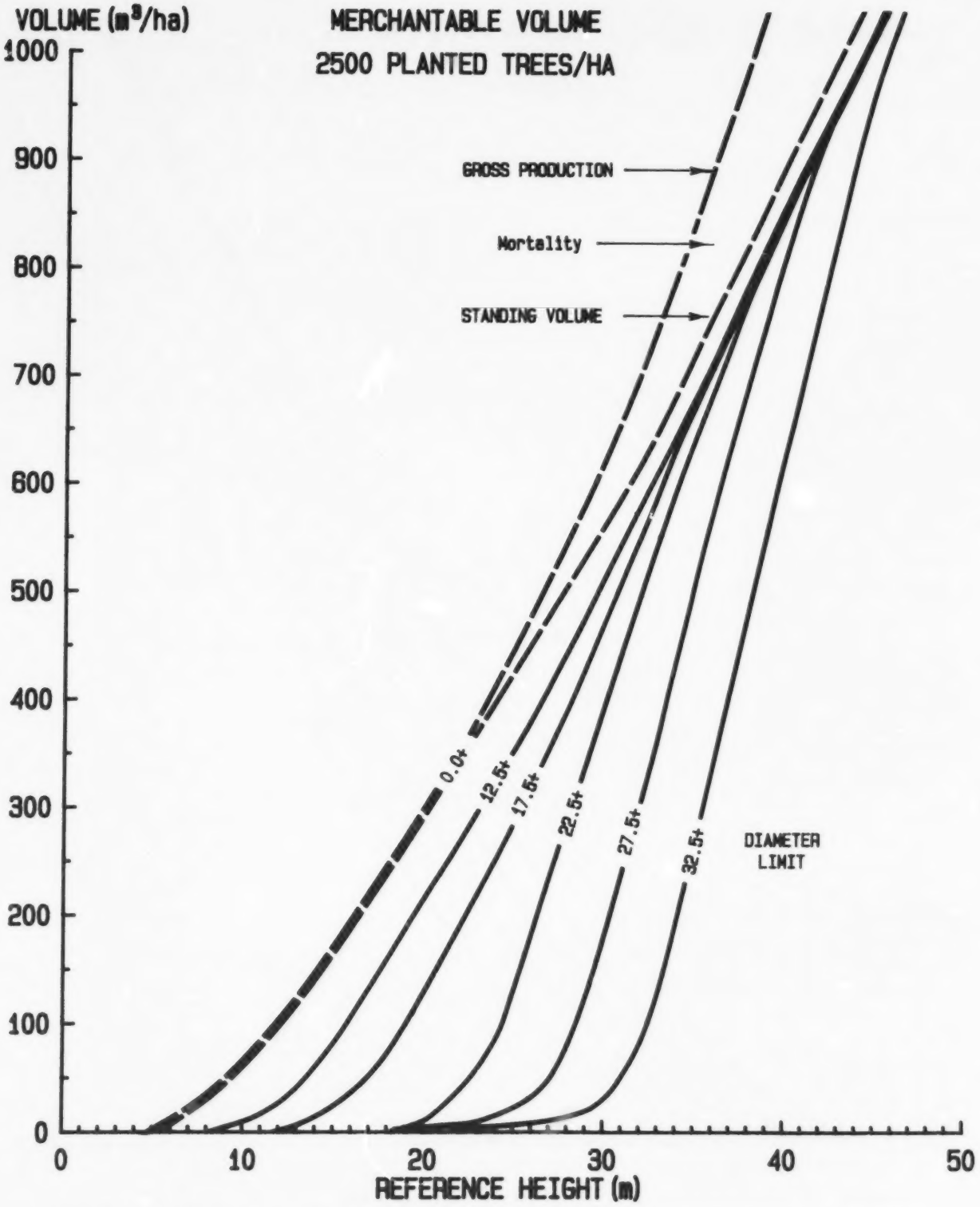

FIGURE A-15. Merchantable volume in relation to height and initial density for stands planted with 2500 trees/ha.

(Fd 1985)

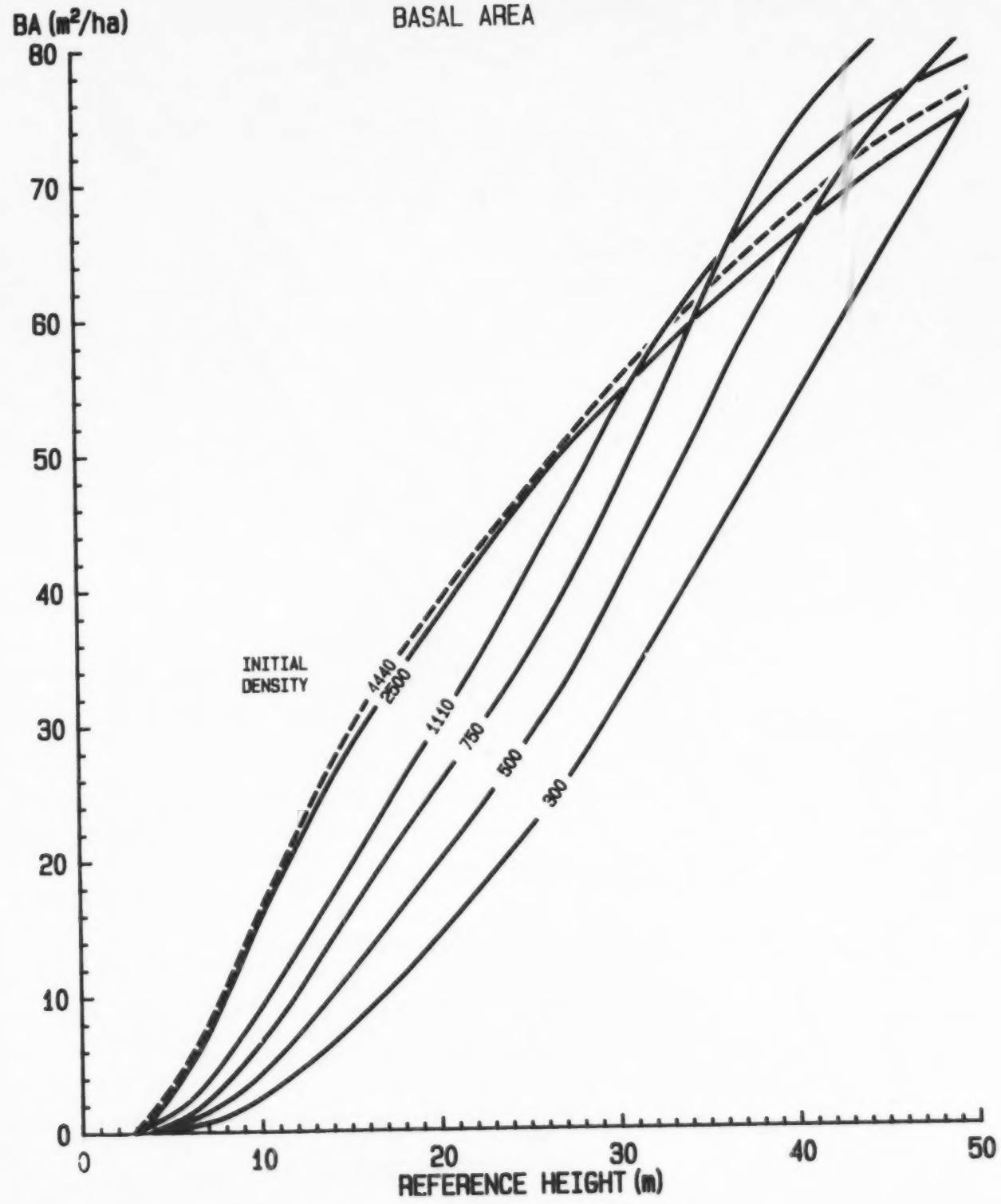

FIGURE A-16. Basal area in relation to height and initial density.

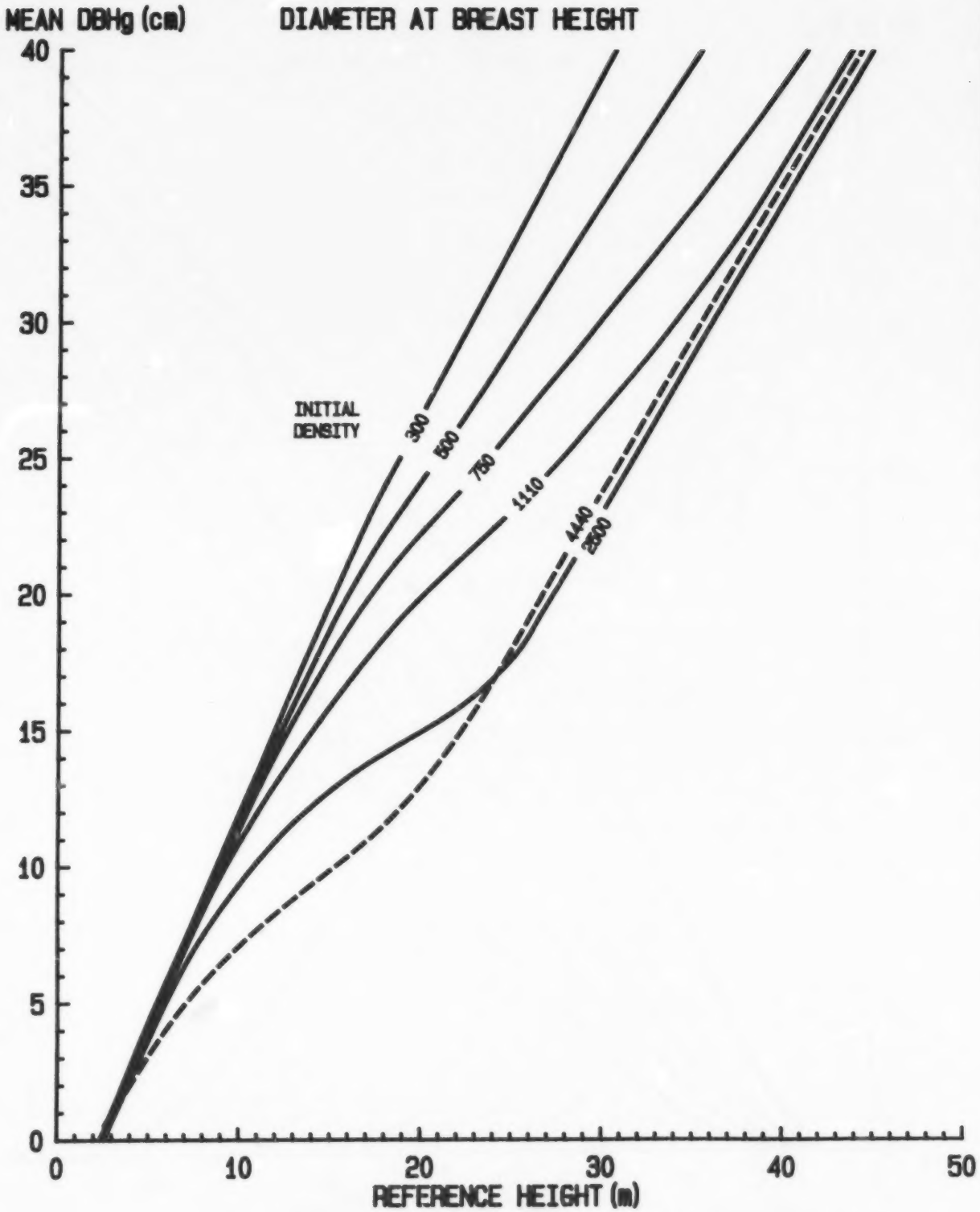

FIGURE A-17. Diameter in relation to height and initial density.

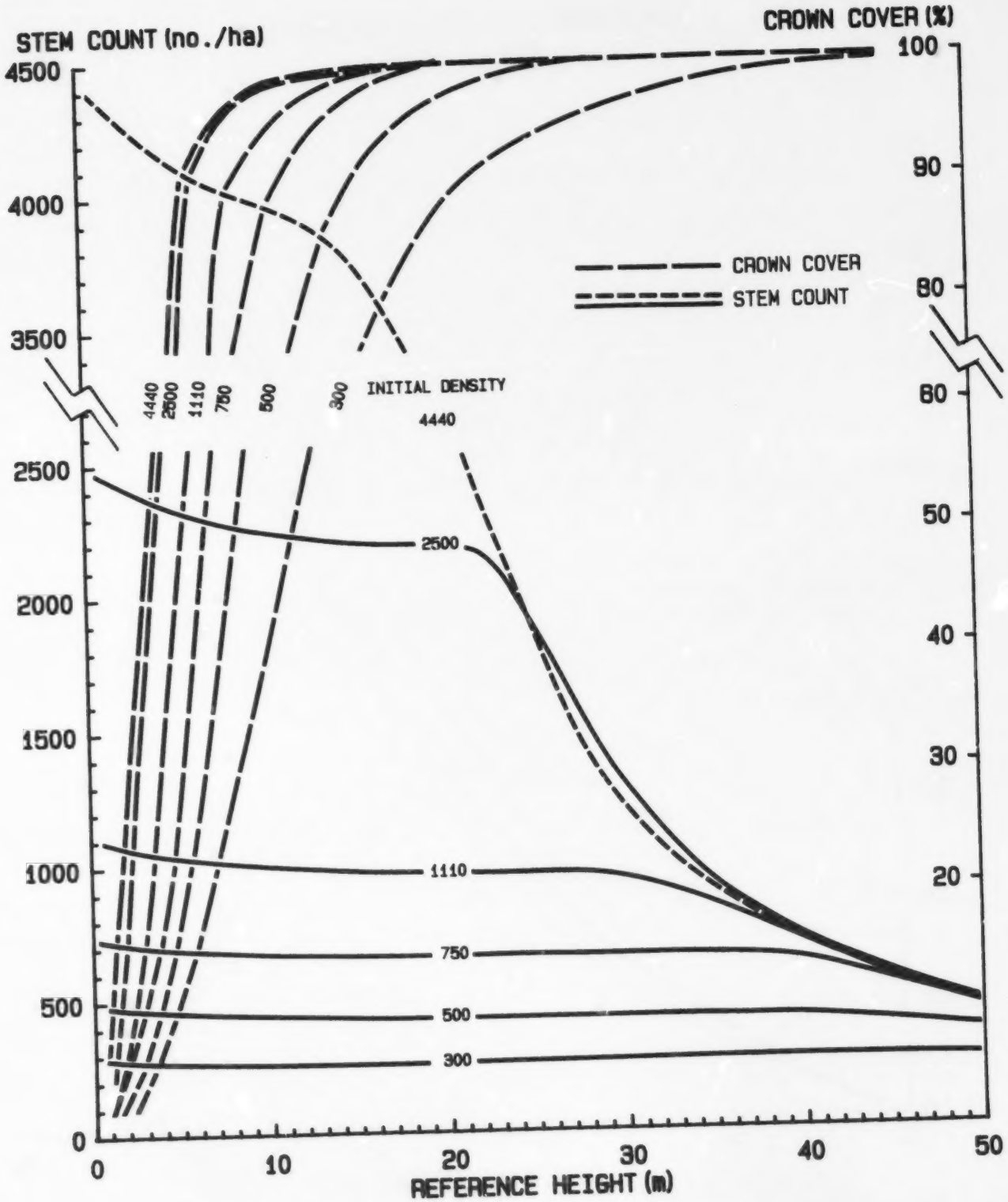

FIGURE A-18. Stem count and crown cover in relation to height and initial density.

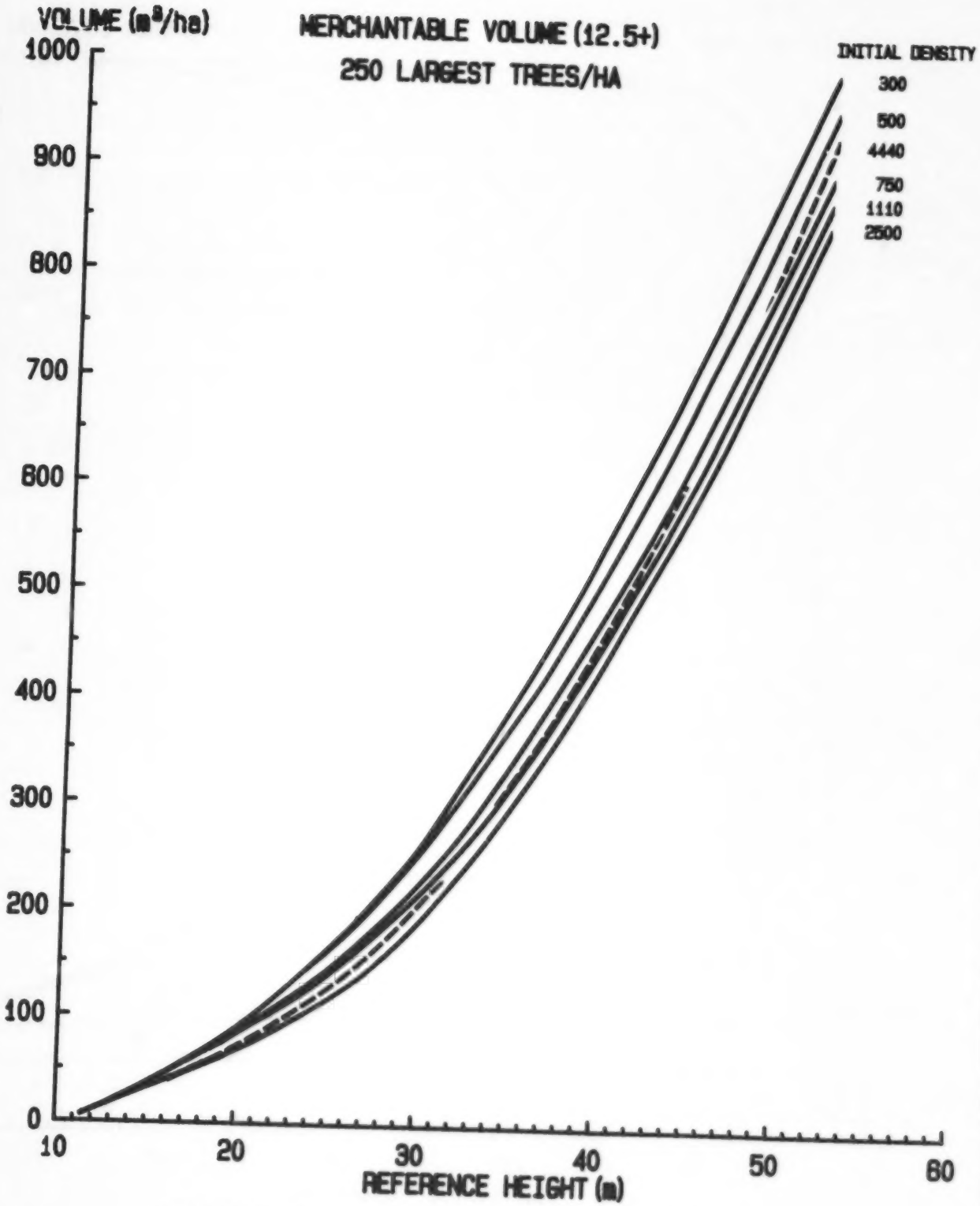

FIGURE A-19. Crop-tree volume in relation to height and initial density.

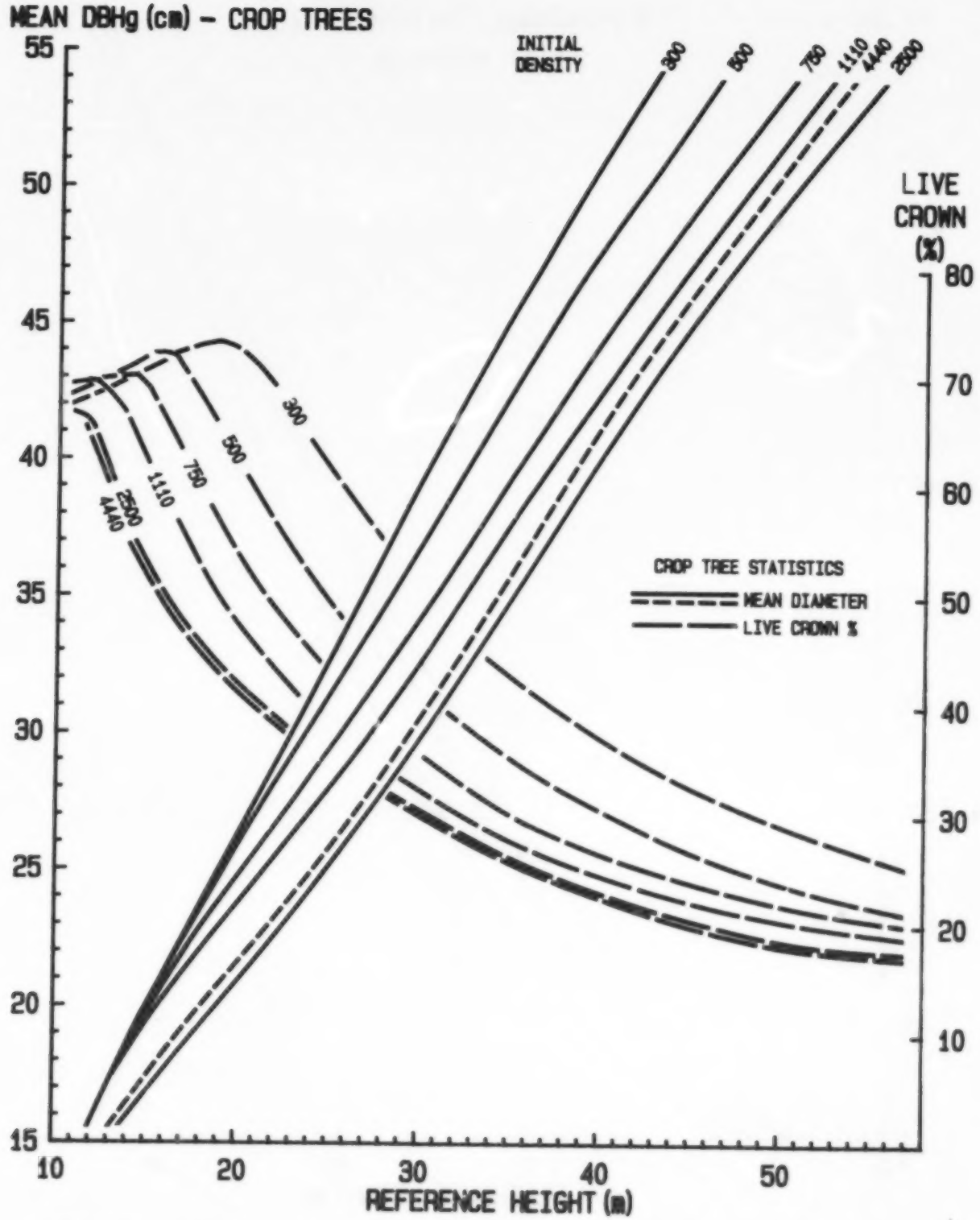

FIGURE A-20. Crop-tree diameter and live crown percent in relation to height and initial density.

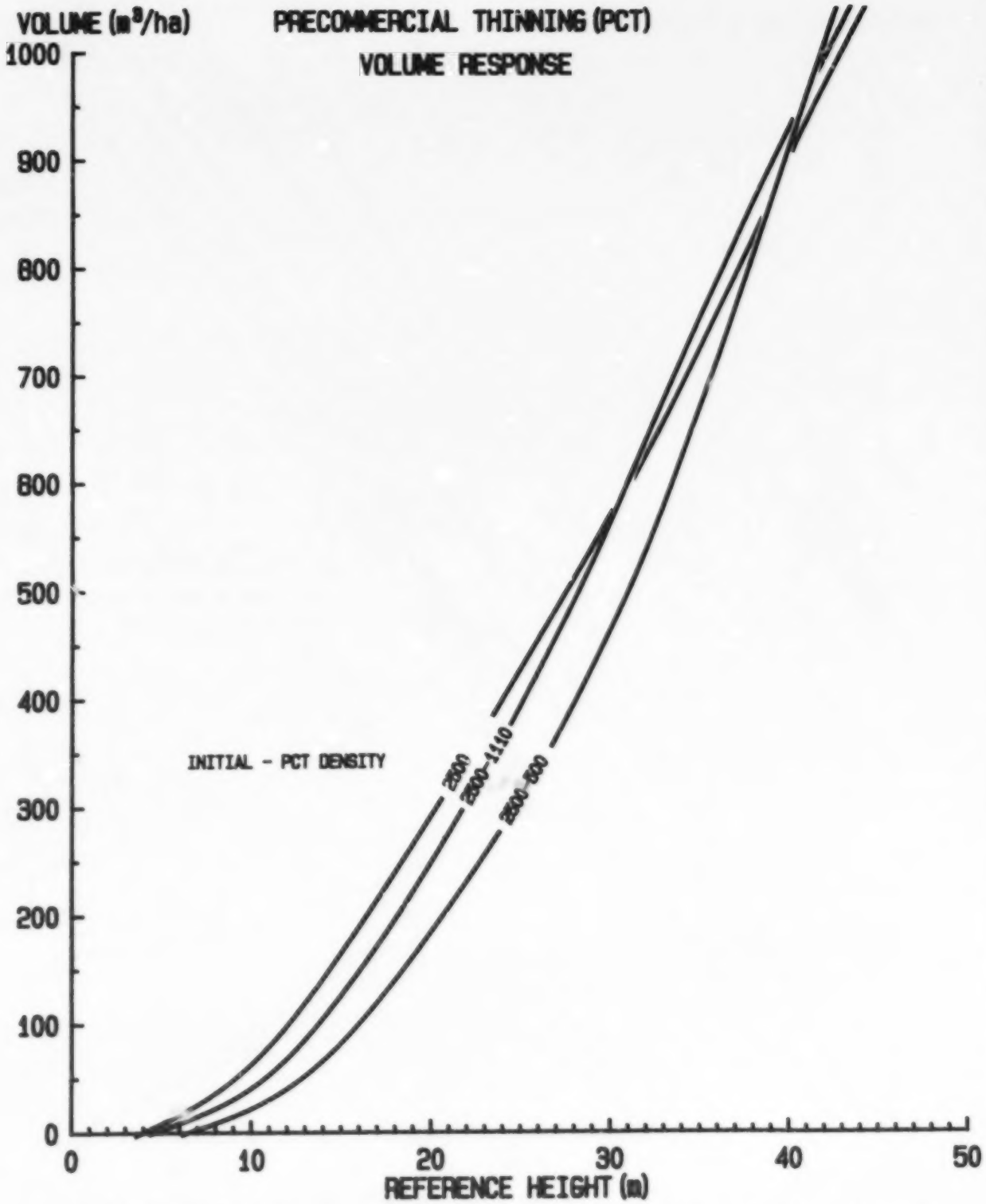

FIGURE A-21. Total standing volume (0.0+) in relation to height and thinning intensity for stands planted with 2500 trees/ha.

(Fd 1985)

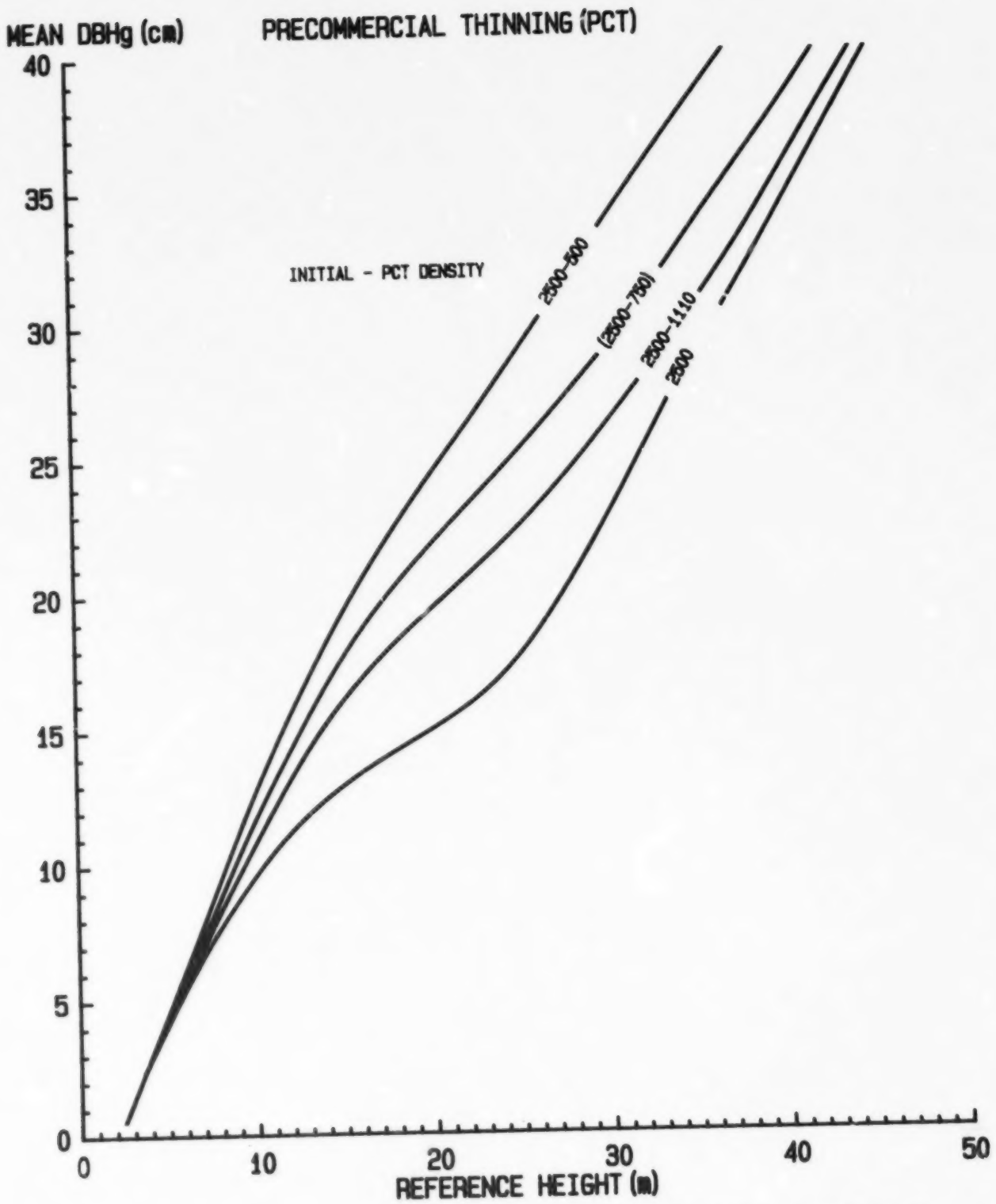

FIGURE A-22. Diameter in relation to height and thinning intensity for stands planted with 2500 trees ha.